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ABSTRACT

This document is the second in a series of three documents, which together contain 27 case studies on the uses of cost analysis in educational planning. The case studies are presented to help planners and administrators see how cost analysis can be used to improve the efficiency of their educational systems, or to get the best value existing resources. Topics examined in these eight case studies include the cost of introducing a reform in primary education in the Ivory Coast, the role of cost analysis in the 1962 reform of primary education in Madagascar, the use of educational cost models in planning the extension of compulsory education in Norway, marginal costs for marginal decisions about team teaching in Barbados, the role of cost analysis in planning a teacher-training program in Poland, and the costing of a program for expanded secondary education in Brazil. Other topics consider the use of cost-benefit analysis both as a guide to educational resource allocation in India and as a tool to compare the rates of return to education in Colombia. (Author/DN)

Titles in the series

Educational cost analysis in action: case studies for planners—I

Tanzania: planning for implementation/Tanzania: factors influencing change in teachers' basic salaries/Ceylon: costing first- and second-level general education / USSR: economic planning and the financing of higher education/USSR: estimating the annual budget requirements of the educational system/France: the use of capital costs in educational planning — the case of the Fifth French Plan/Thailand: educational cost analysis/Thailand: the use of cost analysis in estimating the total cost of an educational plan and testing its feasibility/Asia: cost analysis in an Asian model of educational development/Chile: evaluating the expansion of a vocational training programme

Educational cost analysis in action: case studies for planners—II

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Published separately

Managing educational costs by Philip H. Coombs and Jacques Hallak

A synthesis report on the IIEP research project. Part I presents highlights of the 27 case studies; Part II provides some basic insights into the nature and behaviour of educational costs that are prerequisite to the practice of cost analysis; Part III gives a wide variety of guides, practical tips and precautions for applying cost analysis in particular situations. (Note: This volume is published by Oxford University Press, New York, London and Toronto).

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Educational cost analysis in action: case studies for planners—II

An IIEP research project directed by
Philip H. Coombs *and* Jacques Hallak

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Preface

During the Second United Nations Development Decade most countries, whether industrialized or 'developing', will be facing increasingly pressing financial strain in meeting their enormous and urgent needs in the realm of education.

Both planners and administrators will in future have to take into greater account the economic aspects involved in their plans, and explore every means of improving the efficiency of their educational systems so as to get the best value from existing resources. Experience has proved that an indispensable technique for this purpose is analysis of the costs of education, by means of which it is possible to:

check the economic validity of educational plans;

draw up a precise programme of expenditure over the planning period;

estimate both the costs and the real economic consequences of specific projects;

facilitate decision-making when several alternative possibilities exist for the allocation of funds.

To illustrate these techniques as clearly as possible the International Institute for Educational Planning (IIEP) put in hand, in 1968, a large-scale research project on the uses of cost analysis in educational planning. The aim of the study was to carry out a pragmatic inquiry into actual practice in order to provide planners with a general view of the various ways of using cost analysis and with practical hints on the application of these ways to their own particular needs. Mr. Philip H. Coombs, the former Director of the Institute, was responsible for the technical direction of the work, assisted by Mr. Jacques Hallak, also of the Institute, and with the co-operation of a number of IIEP staff members; the project took over two years and was carried out in three stages.

In the first stage, a methodological note was prepared, laying down the general lines on which the research would be carried out. As many examples as possible of experiences in this field were considered, from which a diversified sample of 27 cases was selected for study in depth.

The second stage was to gather and analyse the statistical information for each case in this sample, and to compile an analytical report based on the data collected for each case study. For these activities the IIEP was greatly

assisted by the co-operation of specialists in the various countries and of international experts, especially those of Unesco.

In the third stage the guidelines and principal lessons emerging from an analysis of all the case studies were summed up by Mr. Coombs and Mr. Hallak in a synthesis report (which is being published separately).

The project was financed principally by the United States Agency for International Development (USAID) and the Swedish International Development Authority (SIDA), to whom the IIEP wishes to express its deepest gratitude. The Institute would also like to thank the many officials, educators, and specialists who, both in the countries studied and in the various Departments of Unesco, have unstintingly given us their assistance in bringing this project to fruition. Responsibility for the content of all reports, however, rests with the authors named.

RAYMOND POIGNANT
Director, IIEP

An introductory explanation

The twenty-seven case studies carried out by the IIEP on the uses of cost analysis in educational planning are extremely diversified in every respect. They are widely scattered geographically; they are fairly well distributed by level and type of education or training (the two notable deficiencies being teacher training and non-formal education); they vary in breadth of coverage, ranging from individual projects to entire formal educational systems; and, most important, they illustrate the diversity of uses to which cost analysis can be put.

Broadly speaking, the cases illustrate seven principal purposes which cost analysis can serve: (1) costing and testing the economic feasibility of educational plans; (2) evaluating and improving the allocation of available educational resources (e.g. by principal levels and types of education); (3) weighing the comparative advantages of alternative ways to pursue the same educational objectives; (4) determining both the short- and long-term cost implications of a particular project; (5) estimating the introductory costs and the likely longer-term cost impacts of a major educational innovation; (6) conducting a general search for ways to improve efficiency and productivity; and (7) checking the economic implications and feasibility of special policy decisions before they are made.

The case studies can also be usefully classified from a different angle, according to three degrees of educational change involved: (1) the linear expansion of an existing educational system or sub-system without substantial change in its characteristics (the simplest case); (2) significant modifications of existing educational arrangements aimed at improving the qualitative performance and efficiency of the system, but still without radically altering its form and methods (decidedly more difficult); and (3) fundamental innovations aimed at drastically altering the system's structure, content, and performance, or even creating alternative teaching-learning 'systems' to replace or supplement the old ones (the most complex case).

About half of the case studies were prepared entirely by IIEP staff members from original documentation, supplemented where necessary by field visits. The rest were prepared under IIEP guidance by outside consultants with first-

hand knowledge of the case in question. The descriptions of the authors given at the opening of each case study refer to the positions they held at the time the studies were prepared.

As might be expected, the cases vary greatly in the amount of evidence available, in the simplicity or sophistication of the methods employed, and in the amount they have to teach to others. Interestingly, when we checked the complete cases with experienced people, there was wide agreement that the 'thin' cases (in terms of the spareness of data available and the crudeness of the method used) were often the most instructive, because educators in other countries could most readily identify their own situation with them.

These cases, it should be emphasized, are not offered as models to be emulated. In fact in no few instances the chief lessons are, in a sense, negative ones; the greatest value lies perhaps in the analysis of the shortcomings of the methods used and in the suggestions of alternative methods that *might* have been used. But above all, the cases lend an air of reality to the whole subject. They demonstrate to the hard-pressed and hard-headed administrator who has grown sceptical of abstract theorizing that his colleagues elsewhere, with problems rather similar to his own, have actually made a stab at cost analysis with useful practical results. Hopefully such an administrator will browse through a few of these cases himself and be inspired to try a few stabs of his own.

P.H.C. AND J. H.
Paris, 1972.

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Ivory Coast 11

The cost of introducing a reform in primary education

prepared by Ta Ngoc Châu

This study was prepared by Ta Ngoc Châu, IIEP, with the assistance of Maureen Woodhall. Philip H. Coombs and Jacques Hallak served as principal advisers to the study. The Institute gratefully acknowledges the helpful co-operation of the government of the Ivory Coast in providing the basic data for the study.

Introduction

Primary education in the Ivory Coast Republic is now facing two important problems. The first is the low output of the primary schools owing to the large number of repeats and, to a lesser extent, to the number of drop-outs. The second problem is the fact that primary schooling has been so far one of the factors influencing rural migration.

The development of primary schooling and the possibility of extending it to the entire school-age population requires certain fundamental changes in order to increase the efficiency of primary schooling and reduce its effect on the population movement towards the cities and towns, in view of the fact that the economy will continue to be predominantly agricultural for quite a number of years.

Moreover, the rapid increase of primary schooling during the last few years has entailed a large increase in the number of pupils admitted to the secondary schools. But the Planning Ministry's forecasts of qualified manpower requirements for the next ten years do not justify the present rate of growth of secondary education. A re-appraisal of the primary-school system is therefore necessary, to prevent increased primary enrolment from causing a corresponding increase in new enrolments at the secondary level.

These considerations pointed to a need for a reform of primary education in the Ivory Coast Republic, involving a new orientation of primary schooling. Since most of the pupils who finish primary school cannot be admitted to secondary schools, post-primary instruction will be specially organized for them—an informal type of instruction given by primary-school teachers with the aid of television. In order to facilitate the organization of this new type of instruction, to increase the yield of primary education, and to accelerate the introduction of a new primary curriculum, two important decisions have been taken by the Ivory Coast government: the large-scale use of school television, and improvement in the qualifications of teachers.

This case study is concerned with the effects of these two decisions on the capital and current costs of primary education and with the question of the financing of this expenditure—in the light of expected future development of available resources and the expenditure required for the other levels of education. Its purpose is not to evaluate the Ivory Coast primary-education reform, nor to pass judgement on the efficiency of school television as a medium of instruction. Rather, the aim is to show how estimates were made of the cost of the reform and the part which cost analysis played in its preparation and planning.

First, however, we give some general information on primary schooling in the Ivory Coast Republic.

I. Recent developments and situation of Ivory Coast primary schools

A. The enrolment increase

From 1958 to 1966, enrolment in public and private primary schools more than doubled, from 165,233 to 381,452. Public school enrolment increased more than that in private schools, whose share of the total declined from 36 per cent in 1958/59 to 27 per cent in 1966/67.

This steady increase in total enrolment, however, conceals two important features: the stabilization of new admissions and the unequal development of the enrolment in different parts of the country. An analysis of enrolment structure in public primary schools by grades shows that while total enrolment regularly increased, the numbers of first-grade pupils tended to become stable after 1962/63.

Thus, the increase in total enrolment during the last few years has been due not to an increased number of new pupils, but to the progression of first-grade pupils through the succeeding grades. While the primary-school enrolment rate for the Ivory Coast as a whole is about 40 per cent, there are great disparities between areas. In the school, districts of the south-east, the Abidjan area, the enrolment rate exceeds 75 per cent, but it declines considerably towards the north-west; in the school district of Séguela, for example, the average rate for the whole district is only 9.7 per cent, which means even lower rates in the completely rural areas.

B. The yield of primary education

In 1966 the Ministry of education published statistics showing the numerical distribution of pupils during the entire duration of school attendance (see Table 1). These statistics identify pupils in different grades according to the year in which they were first registered for primary-school attendance; thus a cohort of pupils, enrolled in a given year, can be followed throughout the period of schooling. It has been found that for every ten thousand new pupils enrolled for the first

TABLE 1. Distribution of pupils by total number of years spent in primary school

Grades (forms)	1st	2nd	3rd	4th	5th	6th
Normal promotion	62 680	38 795	31 605	23 432	18 825	15 145
+ 1 year	28 183	21 773	20 591	17 281	16 415	15 162
+ 2 years	1 978	4 346	6 458	6 445	7 199	8 441
+ 3 or more years	418	664	1 459	1 336	1 583	1 531
Total	93 259	67 578	60 113	48 494	44 022	40 279

SOURCE Ivory Coast Ministry of national education, *Situation de l'Enseignement au 1er janvier 1966* (Educational Situation as of 1 January 1966), Abidjan, 1966, p. 122.

grade, 818 receive their primary-school certificate at the end of six years (the normal period of primary schooling), 1,040 at the end of seven years, 671 at the end of eight years and 86 at the end of nine years or more, making a total of 2,615 who finally complete their primary schooling. In order to produce these 2,615 primary-school graduates, 55,959 pupil years were needed, in other words 21.39 years per primary-school graduate, instead of the theoretical six years.

This method of measuring output tends, however, to under-value the real yield; it does not take into account drop-outs, who have nevertheless acquired a certain minimum of knowledge, even though not completing their primary schooling.

If we assume that those who have successfully completed the first four years of primary schooling will be capable of retaining and developing the knowledge acquired at school, then a second estimate of output can be made. 5,832 out of every 10,000 pupils starting the first grade successfully complete the first four grades. However, in order to produce these 5,832 pupils, 41,460 pupil years of schooling were necessary, or 7.10 years per pupil instead of the minimum of four years.[1]

Thus, in whatever way it is defined, the output of primary education in the Ivory Coast seems very low and needs to be improved.[2]

C. Expenditure and unit costs of primary education

The national budget constitutes the main source of finance for primary education, although the local authorities, in particular the villages, have resources of their own and devote part of them to education, mainly in the form of capital expenditure. It is, however, very difficult to estimate local expenditures on education, because the local budgets do not isolate such expenditures and also because their share cannot always be assessed in monetary terms.

Foreign aid also plays a part in the financing of education by contributing towards the salaries of technical assistants, although there are few technical assistants engaged in the primary-school system (37 in 1967/68). The share of external aid in the costs of primary education is therefore very small.

Table 2 shows the amounts and percentages of the national education budget and of the entire government budget allocated to primary education between 1961 and 1967.

The figures given cover only the direct costs of the teaching staff and other personnel and equipment. Even so, they amount to more than 40 per cent of the

1. Similar results, based on different methods of calculation, were obtained in IEDES, *Les rendements de l'enseignement du premier degré en Afrique francophone* (Primary-education yield in French-speaking Africa), Vol. 3 — *Analyses nationales* (Country Studies), *Ivory Coast*, Paris, 1967, pp. 31–36.

2. This low primary-school yield is not by any means limited to the Ivory Coast. Similar figures, and an even lower yield, can be found in some of the other French-speaking African countries. See, for example, the work cited in the previous footnote.

TABLE 2. Proportion of education budget and of national budget allotted to primary education (current expenditures) (in millions of CFA francs)

Year	National budget	Educational budget	Allocation for public primary schools[1]	% of educational budget	% of national budget
1961	27 210	4 566	1 593	34.8	5.8
1962	26 770	5 748	1 958	34.0	7.3
1963	27 496	6 125	2 150	35.1	7.8
1964	29 108	6 317	2 410	38.1	8.2
1965	31 875	6 949	3 005	43.2	9.4
1966	36 300	8 091	3 524	43.5	9.7
1967	39 800	8 600	3 589	41.5	8.9

1. Technical assistance, scholarships and grants or subsidies not included.

SOURCE Ivory Coast Ministry of national education, *Situation de l'enseignement au 1er janvier 1966*, Abidjan, 1966, pp. 3-4 and *Programme d'Action pour le développement de l'enseignement du 1er degré en Côte-d'Ivoire de 1968 à 1980*, Abidjan, 1968, pp. 167-68.

national educational budget and nearly 10 per cent of the entire government budget.

Table 2 shows only recurrent expenditure, and in order to estimate the total cost of public primary schooling the following items also need to be included: (a) costs of general administration and common services; (b) welfare expenditures to encourage school attendance (e.g. lunches, transportation, scholarships, etc.); and (c) depreciation and amortization of capital investments. In addition, for some purposes, such as estimating the total resource requirement of a large-scale expansion of primary schooling, it may be necessary to include the cost of training primary-school teachers.

The total staff and equipment costs of the Ivory Coast public primary schools more than doubled from 1961 to 1967. This was due to the increase in the number

TABLE 3. Total costs and average unit costs for staff and equipment of public primary education in the Ivory Coast Republic, 1961–67

Year	Total costs (in thousands of CFA francs)			Adjusted enrolment figures[1]	Average unit costs (in CFA francs)		
	Staff	Equipment	Total		Staff	Equipment	Total
1961	1 389 628	202 740	1 592 368	170 339	8 158	1 190	9 348
1962	1 675 229	283 000	1 958 229	197 582	8 479	1 432	9 911
1963	1 867 000	283 000	2 150 000	227 481	8 207	1 244	9 451
1964	2 093 000	316 500	2 409 500	239 738	8 730	1 320	10 050
1965	2 715 000	289 500	3 004 500	252 438	10 755	1 147	12 902
1966	3 099 000	424 500	3 523 500	260 978	11 875	1 627	13 501
1967	3 202 725	377 000	3 579 725	280 000[2]	11 438	1 346	12 784

1. The enrolment figures have been adjusted to allow for the fact that the school year does not coincide with the budget year.
2. Estimation.

SOURCE Ministry of national education, *Situation de l'enseignement*, op. cit., p. 3, and *Programme d'action*, op. cit., p. 10.

of pupils and in the average per-pupil expenditure on staff and equipment, as shown by Table 3.

Average per-pupil expenditures have increased rapidly since 1963, due mainly to higher expenditure on teachers and other personnel. Equipment costs do not show any decided trend, and their percentage in the total cost has fluctuated between 9.6 per cent in 1965 and 14.5 per cent in 1962.

The increase in staff and personnel costs is due partly to the higher salaries of teachers and other public service employees and partly to better qualifications of the teachers.[1] Between 1965 and 1967 the percentage of monitors remained relatively steady at 27 per cent, but the percentage of assistant monitors declined considerably. The proportion of teachers and assistant teachers increased from 45 per cent to 62 per cent.

D. Effect of the development of primary schooling on secondary education

Owing to the rapid increase in the number of primary-school leavers, new admissions to the secondary schools have also increased rapidly in recent years (see Table 4).

TABLE 4. New admissions to public and private secondary schools, 1958–65

Year	Number	Year	Number
1958/59	2 039	1962/63	5 243
1959/60	3 477	1963/64	5 571
1960/61	4 328	1964/65	6 215
1961/62	4 778	1965/66	8 509

SOURCE IEDES, *Les rendements de l'enseignement*, op. cit., Vol. II, *Données numériques* (Numerical Data), p. 32, and Ivory Coast Ministry of national education, *Situation de l'Enseignement*, op. cit., p. 60.

In the seven years from 1958 to 1965 the number of new admissions to secondary schools more than *quadrupled*, an average annual increase of 22 per cent. This steady increase of entrants inevitably leads to a rapid increase in the number of secondary-school graduates several years later, and consequently to increased pressure for admissions to institutions of university level.

1. *Assistant monitors* are recruited at the level of the final grades of primary school and are not required to pass any examination. *Monitors*, besides holding the primary-school certificate, must pass an examination entitling them to the Monitor's Certificate. *Assistant teachers* are recruited at the end of the first cycle of secondary education. They receive one year of professional instruction in teacher-training centres (CAFOP) and receive the initial Elementary Teacher's Certificate. *Teachers*, with the full title, are recruited *on a competitive basis* after graduation from the first cycle of secondary education. They receive three years of professional training at the Teacher-training college and are then awarded the full Teacher's Certificate.

TABLE 5. Estimated new enrolments in institutions of higher education to meet manpower requirements forecast in the Plan

	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76
University								
Arts and letters	20	30	50	70	70	70	70	70
Law	35	50	70	100	100	100	100	100
Medicine-pharmacy	12	18	25	40	40	40	40	40
Sciences	25	30	50	70	70	70	70	70
Institutions of university level								
Commerce	35	50	75	130	130	130	130	130
Engineering	35	50	75	130	130	130	130	130
Administration	35	35	50	50	50	50	50	50
Agriculture	14	40	60	50	50	50	50	50
Others	42	58	65	60	60	60	60	60
University Institute of Technology				150	620	700	800	800
Total number of university graduates required	253	361	520	850	1 320	1 400	1 500	1 500

SOURCE Ivory Coast Directorate for Encouragement of Productivity, *Eléments pour une loi-cadre de l'enseignement*, Abidjan, 1968, p. 96.

According to the latest educational plan, which was based on estimates of future manpower requirements, new admissions to higher education are expected to follow the trend shown in Table 5.

The number of university graduates is thus expected to increase rapidly during the coming years, but it has been estimated that the secondary schools will be fully capable of supplying sufficient numbers of candidates for higher education. In fact, the plan estimates that even if admissions to secondary school are stabilized at their present level of 10,000 each year, at least until 1974/75, the secondary schools will be capable not only of providing the required number of candidates for the university level but also of supplying the necessary number of students for vocational and technical schools, to meet qualified manpower requirements. Figure 1, prepared on the basis of new assumptions on flow-rates, shows the theoretical flow of an enrolment of 10,000 pupils entering secondary school in the school year 1968/69.

The Ministry of education recognizes the difficulties involved in stabilizing secondary-school admissions but is nevertheless convinced that a continuing increase in the number of secondary-school entrants would require too great an outlay in terms of classrooms, equipment and teachers, and that increased enrolment at the lower-secondary level could be achieved only at the expense of higher levels.

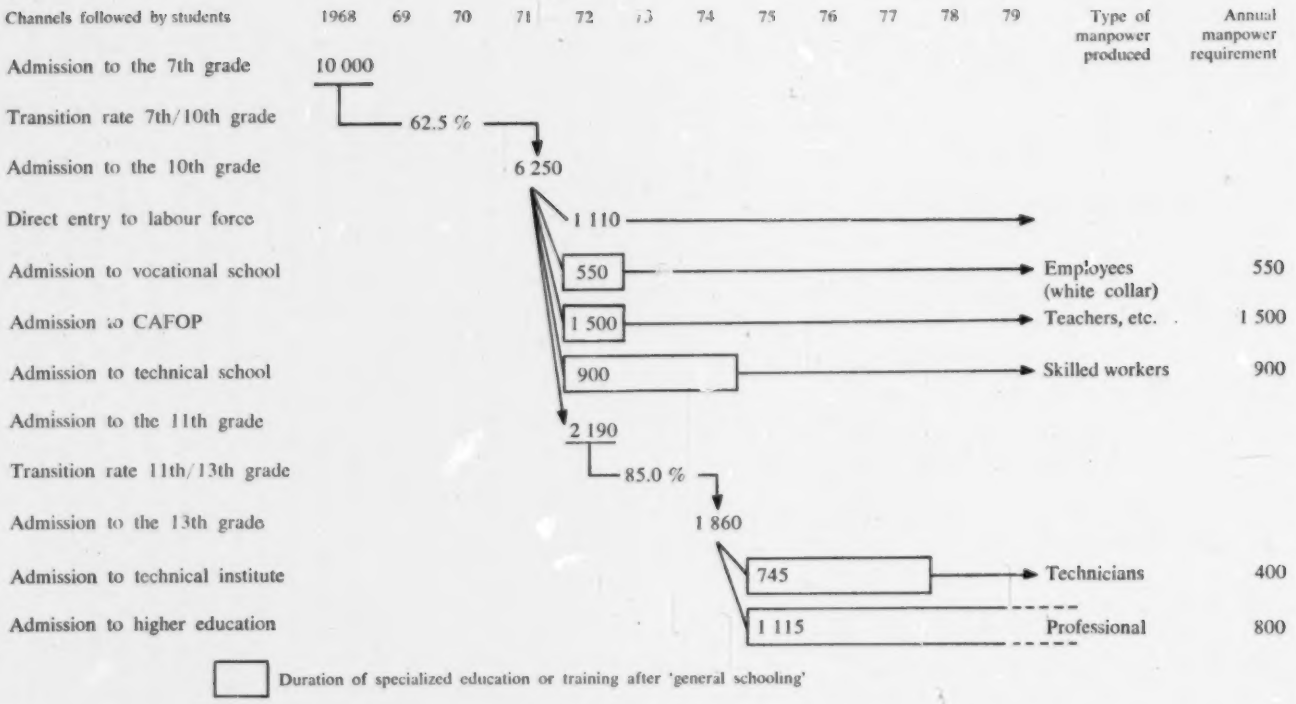

FIGURE 1. *Flow of students admitted to secondary school (7th grade) through the educational system.*

TABLE 6. Forecast of enrolment in different grades of public secondary education in the Ivory Coast Republic

Grades	1967/68	1968/69	1969/70	1970/71	1971/72	1972/73	1973/74	1974/75
7	9 750	10 500	10 500	10 500	10 500	10 500	10 500	10 500
8	8 260	8 200	8 900	8 900	8 900	8 900	9 000	9 000
9	4 715	6 700	6 450	7 900	7 900	7 900	7 900	8 000
10	3 760	4 500	5 400	6 250	6 650	6 650	6 650	6 650
Totals for 1st cycle	26 485	29 900	31 250	33 550	33 950	33 950	34 050	34 150
11	900	2 200	2 200	2 200	2 200	2 400	2 400	2 400
12	635	1 115	2 050	2 050	2 100	2 150	2 200	2 200
13 (final)	670	970	1 070	1 900	1 900	1 950	2 000	2 000
Totals for 2nd cycle	2 265	4 285	5 320	6 150	6 200	6 500	6 600	6 600
Graduates[1]	250	360	520	850	1 320	1 400	1 500	1 500

1. The graduates are those who have passed the final examination at secondary level and received the *baccalauréat*. Figures given include graduates from private schools.

SOURCE Ivory Coast Directorate for Encouragement of Productivity, *Eléments*, op. cit., pp. 74-75.

If this policy of restricting admissions to the secondary schools is successful, enrolment in the first cycle of secondary education could be stabilized from 1970/71 and in the second cycle from 1972/73, as shown in Table 6.

From 1967/68 to 1974/75 it is estimated that total secondary enrolment will increase from 28,750 to 40,750—an increase of 42 per cent—but this relatively low increase in total enrolment will be accompanied by a profound change in the grade structure. The numbers in the final grades will be more than tripled and the number of graduates, including those from private schools, will be increased six times.

Obviously a policy of limiting entry to secondary schools will mean that only a proportion of primary-school leavers who qualify will be able to continue to the secondary level. Primary education is therefore being reformed in two ways: by the introduction of an informal type of post-primary schooling for those not entering secondary school, and by a general improvement in the quality and efficiency of the education provided at the primary level. Educational television will play an important part in achieving both these aims. It has been decided that television will be introduced throughout the primary level, and in addition the informal post-primary education will be provided after normal school hours, so that primary-school premises and television equipment, and also primary-school teachers, can be made use of to the maximum extent. This clearly imposes new demands upon primary-school teachers, so that the government was faced with the need to improve teacher qualifications. The following section will examine the alternative policies on the upgrading of teachers that were open to the Ivory Coast government, and the cost implications of each. The subsequent section will deal with the cost of introducing educational television, and the last part will estimate the total cost of the primary-school reform, and its financial feasibility.

II. The upgrading of teacher qualifications and its effect on costs

With the introduction of school television, several possibilities were available to the Ivory Coast government with regard to the standard of teacher qualifications which would be required.

1. To use teachers of low qualifications (pedagogical assistants paid on the same scale as assistant monitors) and supplement this instruction by the use of televised lessons.[1]
2. The first solution together with increased supervision, by means of an increase in the number of instructional advisers; there are only nine of these advisers at the present time and their supervision is more symbolic than real.
3. To improve the quality of the teaching by improving the level of qualifications of all teachers. This would mean upgrading the unqualified teachers now in service (monitors and assistant monitors) and recruiting new instructors at the assistant teacher level.

Decisions also had to be made regarding pupil/teacher ratios and school equipment and supplies. The present ratio of 47:1 is considered too high; school supplies, moreover, appear to be inadequate.

A rough estimate was made in the Plan of the effect on per-pupil expenditure of introducing each of these improvements, (i.e. the direct cost of primary education to the central government). The calculations were based on the 1967 budgetary costs of teachers and school supplies divided by enrolment in the public primary schools for the school year 1966/67, with some allowance made for administration and common service costs. This method of calculation is only approximate, since it uses budgetary allocations and not actual expenditures and also since the budget year does not coincide with the school year.

The first step was to analyse the composition of, and the expenditure on salaries for the teaching force in 1967. This provided a basis for calculating the additional salary costs that would be involved by an upgrading of teacher qualifications.

TABLE 7. Composition of teaching staff and salaries, 1967

Category of instructor	Number	Annual salary in CFA francs		Salary adopted for cost calculation
		Beginning	Maximum	
Teachers	635	652 368	1 408 284	783 000
Assistant teachers	2 551	434 904	776 628	522 000
Monitors	1 762	341 736	591 876	410 000
Assistant monitors	1 037	238 164	476 340	286 000
Total	5 985			

SOURCE Ivory Coast Ministry of national education, *Programme d'action*, op. cit., pp. 56, 146, 154.

1. For details concerning the different categories of teachers and their qualification level see note, p. 17.

Table 7 shows the composition of the primary-school teaching force in 1967, and the salary scale then in operation. The last column shows the level of salary assumed by the Plan for its cost calculations.

For reasons not specified, the salary figure adopted for the cost calculations is 20 per cent above the beginning salary for each category of instructor. It is assumed that the average seniority of the teaching force justifies this choice of that salary level. It should be noted, however, that the salary range is different for the different categories of instructors. The difference between the beginning salary and the maximum salary is 1 to 2.15 for full teachers, 1 to 1.78 for assistant teachers, 1 to 1.73 for monitors and 1 to 2 for assistant monitors. The Plan does not make any alternative assumptions about salary levels, but later in this case study we will examine the effects on costs of adopting such alternatives.

A. The cost effect of solution (i)

The cost effect of the general use of 'pedagogical assistants' was estimated very simply by calculating the total salary bill on the assumption that every teacher was paid the assumed salary of an assistant monitor (286,000 francs), and subtracting this from the total salary bill calculated on the basis of the grade-by-grade distribution of teachers. This calculation produced an estimated total saving of 1,136,119,000 francs, or 4,000 francs per pupil. The estimated unit cost would therefore be 13,500 − 4,100 = 9,400 CFA francs if the first solution were adopted.

This method of calculation is very rough. Although the general use of 'pedagogical assistants' would of course bring about a reduction in unit costs, that reduction could only be *gradual*, as new instructors are recruited at the level of assistant monitors. There would be no question of replacing the entire present teaching staff by assistant monitors, and much less of reducing their salaries. Thus the actual saving in salary costs would depend on the rate of replacement.

The Plan did not consider this point, but to give an idea of the size of the possible reduction in costs due to the recruitment of new instructors at the assistant monitor level, we have estimated in Table 8 what the structure of the teaching staff would be in 1974/75, assuming (a) that all new teachers recruited will be at the assistant monitor level (which implies a transformation of the six existing

TABLE 8. Projection of instruction staff under different loss assumptions

Category of instructor	Present structure	Structure in 1974/75	
		Low assumption 1 per cent	High assumption 3 per cent
Assistant monitors	1 037	5 802	6 594
Monitors	1 762	1 621	1 339
Assistant teachers	2 551	2 347	1 939
Teachers	635	584	482
Total	5 985	10 354	10 354

TABLE 9. Forecast of total expenditure and per-pupil expenditure on teaching staff under different assumptions of teacher loss (in thousands of CFA francs)

		1974/75	
	1966/67	Low assumption	High assumption
Assistant monitors	296 582	1 659 372	1 885 884
Monitors	722 420	664 610	548 990
Assistant teachers	1 331 622	1 225 134	1 012 158
Teachers	497 205	457 272	377 406
Total cost of teaching staff	2 847 729	4 006 388	3 824 438
Number of pupils	277 260	480 000	480 000
Per-pupil expenditure on teacher salaries	10 271	8 346	7 967

CAFOPS); (b) that the number of instructors will increase proportionately with the number of pupils; and (c) that the rate of instructor loss (by leaving, retirement or death) is 1 per cent per annum (low assumption) or 3 per cent (high assumption).

If, for the moment, we simplify the calculation by assuming that regardless of their increased seniority the monitors, assistant teachers and full teachers would continue to be paid at their present levels, the total costs and unit costs of the teaching staff in 1974/75 would correspond to those shown in Table 9. In fact, of course, the actual cost would depend upon the seniority of the teachers, and a calculation based on an assumed distribution of teachers by seniority will be given in Part IV. Meanwhile we may note that even if we under-estimate expenditure in 1974/75, by making this simplifying assumption, and even if we assume eight years of systematic recruiting of assistant monitors, the cost reduction proves to be only between 1,925 and 2,304 CFA francs, according to which assumption about the rate of teacher loss is adopted. The average of these two figures, 2,100 CFA francs, is a figure roughly half the estimate made in the Plan, which was 4,100 CFA francs.

B. Effect of solution (ii) on teaching costs

The Plan considered that proper pedagogical supervision requires a minimum of one half-day inspection per month of each class by an instructional adviser. On the basis of twenty school days per month, a travelling adviser would visit 40 classes per month, which calls for 150 advisers for 6,000 instructors.

Assuming that pedagogical advisers receive the same salary as full teachers,[1] such an increase in the pedagogical service would entail an additional salary cost of 783,000 × 150 = 117,450,000 CFA francs, to which must be added travel

1. At the present time, the pedagogical advisers are teachers, but they receive a bonus of 180,000 CFA francs for that function in addition to their teacher salary.

expenses estimated at 30 million CFA francs. This would mean that salary costs per pupil would be increased by 530 CFA francs, raising the previous estimate of unit cost which assumed general use of assistant monitors to 9,930 CFA francs.

C. Effect of solution (iii) on teaching costs

While the general use of 'pedagogical assistants' would bring about a decrease of costs, the systematic recruiting of instructors at the level of assistant teachers would increase the unit cost. The Plan estimated the increase in cost of this alternative by assuming that all monitors and assistant monitors would be paid the assumed salary of an assistant teacher (522,000 francs). This would involve total additional teacher expenditure of 442,076,000 francs, or an increased teacher cost per pupil of 1,600 CFA francs, making the salary cost per pupil 15,100 CFA francs.

This method of calculation based on salary differentials over-simplifies the situation by making no allowance for the seniority of the existing instructors. The maximum final salary of a monitor (591,876 CFA francs) and even of an assistant monitor (476,340 CFA francs) is *higher* than the beginning salary of an assistant teacher (474,904 CFA francs). The calculations, however, assumed that the salary for all categories of instructors was the initial salary plus 20 per cent. The problem is to know exactly what the salary level for monitors and assistant monitors would be after they have been upgraded and promoted to assistant-teacher level. The Plan's calculations do not take account of this problem and only salary differentials, not including family allowances and other benefits, were considered.

In any case, the additional training of instructors requires time, and the replacement of monitors and assistant monitors can only be done gradually—with the result that the increase in costs would be gradual and spread out over a certain number of years. We shall discuss below how the effect of the alteration of the teaching-staff structure according to qualifications and seniority can be estimated more accurately, but for the moment these calculations give a rough idea of the relative costliness of the three policies concerning the qualifications of teachers.

D. Cost effect of reducing the pupil/teacher ratio

In 1967 there was an average of 47 pupils per instructor. This average actually covers a wide diversity of situations; in extreme cases, and especially in the first two grades, there was a very high number of pupils per instructor.

The Plan considered two possibilities: the reduction of the pupil/teacher ratio to 44 and to 40. If the ratio were reduced to 44 or to 40, other things being equal, the unit teaching cost would be increased by 6.8 per cent or by 17 per cent respectively.

It must be noted that a reduction of the pupil/teacher ratio not only entails increased expenditure but also requires an increase in the number of teachers. The policy of reducing the pupil/teacher ratio cannot be adopted unless teachers are trained at a faster rate. If such a policy were accepted, it would considerably increase teacher demand, over and above the normal increase due to the annual increase in enrolment. Everything will therefore depend on the admission capacity of the teacher-training centres.

Moreover, a reduction of the pupil/teacher ratio would involve increased capital expenditure, because more classrooms will be necessary for the same number of pupils and additional costs of maintenance and equipment will have to be met (to the extent that such costs depend on the number of classrooms and not on the number of pupils). Therefore the total effect on costs of reducing the pupil/teacher ratio will be greater than the simple increase in salary expenditure.

E. Cost effect of increased school supplies

In 1967 the funds allocated for school supplies amounted to 158 million CFA francs, in other words 570 CFA francs per pupil.[1] The Plan considered this figure insufficient and attempted to assess the level of supplies desirable both for traditional methods of teaching and for instruction with television, which requires supplementary materials to replace textbooks used in traditional teaching.

These new estimates of supply expenditures per pupil are as follows:

	(in CFA francs)
(a) *Traditional teaching methods*	
Collective classroom material	71
Textbooks for pupils	780
Other school supplies	220
Total	1 071
(b) *Teaching by television*	
Supplementary materials accompanying television lessons	825
Other school supplies	220
Total	1 045

F. Summary of cost effects of alternative policies and the solution adopted by the government

Table 10 shows the required salary expenditure in the case of an increase in the proportion of qualified assistant teachers, or in the case of utilization of assistant

1. This item concerns only the expenditure for school supplies. The total expenditure for equipment is larger. See Table 3, p. 16.

TABLE 10. Unit costs of teaching staff and school supplies under different assumptions (in CFA francs)

	Instruction by assistant teachers	Instruction by assistant monitors	
		Figures given by the Action Plan	Corrected figures[1]
47 pupils per teacher	15 100	9 400	11 400
44 pupils per teacher	16 088	10 036	12 175
Increased school supplies	16 588	10 536	12 675
Pedagogical supervision			
one visit per month	17 154	11 102	13 241
two visits per month		11 662	13 807

1. See *supra*, pp. 22-23.

monitors. The latter figure is estimated both in terms of the Plan's simplifying assumptions, and in terms of more realistic assumptions about the rate of recruitment.

Part III of this study gives details of the estimates of the costs of school television. The Plan estimated that the per-pupil cost of television would vary in the following way according to the number of pupils:

Enrolment	*Unit cost (in* CFA *francs)*
50 000	7 800
100 000	4 050
500 000	1 260
1 000 000	930

On the basis of these figures, the Plan concluded that for over 100,000 pupils instruction by television with assistant monitors costs less than the traditional method of teaching with assistant teachers. This conclusion, however, depends on the fact that the Plan over-estimated the reduction in the unit cost due to general recruiting of instructors at the assistant monitor level. As previously pointed out, the Plan produced an estimate of 4,100 CFA francs for the saving, but the calculations in this study suggest that it would be more realistic to assume a figure of about 2,100 CFA francs.[1] Therefore, the threshold at which television instruction with assistant monitors would cost less than the traditional teaching method with assistant teachers would be nearer 300,000 pupils.

Be that as it may, the Ivory Coast government finally chose the higher alternative, that is to say the use of televised instruction with assistant teachers plus increased pedagogical supervision. The unit cost of this alternative has been estimated by the Plan at 18,000 CFA francs. The Plan then evaluated the number of pupils who could be enrolled in the future at this unit cost, by estimating expenditure in the years 1975 and 1980.

1. See *supra*, pp. 22-23.

The level of government expenditure has been decided upon and primary education will receive 8,300 million CFA francs in 1975 and 12,000 million CFA francs in 1980. However, certain expenditures which are directly or indirectly connected with primary education are not included in these estimates. The following amounts have been indicated for 1975 but have been earmarked for the general education system rather than specifically for primary education, or allocated to other sections of the educational budget.

	(in CFA francs millions)
Teaching equipment and supplies	80.0
Subscription to teachers' magazine	7.3
Programmed instruction	20.0
School lunches	48.0
Educational and vocational guidance	200.0
Teacher-training college	50.0
Primary and pedagogical inspection	400.0
Operation of teacher-training centres (CAFOPs)	675.0
	1 480.3

Some of these expenses were included in the computation of the unit cost of primary schooling, in particular expenditure for equipment and supplies, and for primary-school inspection.

In order to estimate the funds allocated to education corresponding to the elements included in the calculation of unit costs, the Educational Plan took the following figures as the total allocations for the financing of primary education:

1975 8 700 million CFA francs
1980 13 000 million CFA francs

They also assumed that the unit cost previously adopted (18,000 CFA francs) will not vary during the period of the forecast and that therefore the number of pupils who can be enrolled in 1975 and 1980 will be as follows:

1975 480 000
1980 720 000

The authors of the Plan also took it for granted that as a result of improvement in instructor qualifications, curriculum change, and the introduction of teaching by television, it will be possible to reduce substantially the number of repeaters, which at present weighs heavily in the enrolment figures of the different grades. In fact, the Ivory Coast Ministry of education advocates the gradual implementation of a policy of automatic promotion. Assuming the successful application of this measure, the Plan forecasts the enrolment structure by grades as in Table 11.

The number of new *first*-grade pupils entering public schools in 1979/80 is expected to be 145,000. If the number of pupils enrolling in private schools is added, the figure becomes 170,000, the total number of six-year-old children in the population forecast for that year. During the following years, these pupils will progress through the school system and by 1985/86 universal primary schooling will be attained.

However, as the authors of the Plan themselves admit, this enrolment forecast is theoretical and optimistic. Nevertheless, it is on the basis of these enrolment

TABLE 11. Projection of future primary-school enrolment, 1973–79

Grades	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
1st	89 000	95 000	105 000	115 000	125 000	135 000	145 000
2nd	83 000	89 000	95 000	105 000	115 000	125 000	135 000
3rd	77 000	83 000	89 000	95 000	105 000	115 000	125 000
4th	71 000	77 000	83 000	89 000	95 000	105 000	115 000
5th	65 000	71 000	77 000	83 000	89 000	95 000	105 000
6th	59 000	65 000	71 000	77 000	83 000	89 000	95 000
Total	444 000	480 000	520 000	564 000	612 000	664 000	720 000

SOURCE Ivory Coast Ministry of national education, *Programme d'action*, op. cit., p. 131.

figures that the introduction of school television has been considered, and its costs calculated.

G. The problem of teacher training

In view of the decision adopted by the Ivory Coast government to make general use of assistant teachers for the primary grades, it will be necessary to upgrade all insufficiently qualified instructors now in service, at monitor and assistant monitor levels, and to increase the output of assistant teachers since the recruiting of new teachers in the future will be only at that level. It will also be necessary to train a number of advisers for supervisory service work.

It has therefore been decided to build a teacher-training college at Bouaké and also to increase from six to nine the number of centres for pedagogical training (CAFOPs). At the present time, full teachers are being trained in a special section of the CAFOP at Dabou. This section recruits student teachers in the final year of secondary education and prepares them in two years for the 'Certificate of Pedagogical Aptitude' (CAP). It will continue to operate until the year when the new teacher-training college produces its first graduating class in 1971/72.

Recruitment of student teachers for the new college will be on a competitive basis. The first-cycle certificate will be required, and only seventy students will be accepted each year. The course will cover three years and the students will be required to pass a final examination, after which they will undergo practical training before receiving the certificate automatically placing them on the government roll as *teachers*.

Assistant teachers will continue to be trained in the CAFOP's, but the curriculum will be entirely revised. They will be recruited at the end of the first cycle of secondary education and will be prepared in one year to receive the Elementary Certificate of Pedagogical Aptitude (CEAP). The capacity of each existing centre is 120 students. The capacity of the new centres will be 240.

1. *Capital cost of extension of teacher-training programme*

The estimated capital cost of the extension of teacher training is shown in Table 12. The table distinguishes between the cost of construction and furniture, which will be financed by the Ivory Coast government, and the cost of audio-visual equipment, which will be financed by foreign aid.

TABLE 12. Capital costs of expansion of teacher-training institutions (in thousands of CFA francs)

	Construction	Furniture	Audio-visual equipment	Total
Six existing CAFOPs	—	—	69 000	69 000
Teacher-training college	153 000	40 000	90 000	283 000
Model CAFOP	109 200	6 515	17 510	133 225
CAFOP at Abidjan	116 700	9 235	21 190	147 125
CAFOP at Man	151 060	10 160	23 665	184 885
Total	529 960	65 910	221 365	817 235

2. *Operating costs*

(a) *In-service training for instructors*

There will be two different programmes: the in-service training programme for monitors and assistant monitors to enable them to become assistant teachers, and the training programme for all instructors to prepare them for teaching with television.

In-service training for monitors and assistant monitors. In 1967/68 the number of assistant monitors and monitors was, respectively, 718 and 1,735. It is estimated that as a result of promotions and drop-outs, the respective numbers of assistant monitors and of monitors to be given further training will be 480 and 1,200 in 1969. The in-service training of assistant monitors will be conducted in three stages of six weeks each during the summers of 1969, 1970 and 1971. The in-service training

TABLE 13. Cost of teacher-training programmes (in thousands of CFA francs)

	1969	1970	1971	1972	1973	Total
Living costs of trainees						
Assistant monitors	9 840	9 840	9 840			29 520
Monitors	4 920	7 380	7 380	17 220	12 300	49 200
Television teaching				21 000	21 000	42 000
Staff and faculty	3 384	3 948	3 948	5 640	5 076	21 996
Total	18 144	21 168	21 168	43 860	38 376	142 716

SOURCE Ivory Coast Ministry of national education, *Programme d'action*, op. cit., p. 92.

of monitors will take place in two stages of six weeks each, extending from the summer of 1969 to that of 1973.

Training for television teaching. This special training will be carried out in four-week courses to be taken by all the 6,000 instructors now in service. It will take place during the school years 1971/72 and 1972/73.

The estimated total cost of these two training programmes is shown in Table 13. It is anticipated that the entire cost of these re-training programmes will be covered by Unicef.

(b) *Costs of teacher-training centres*

A detailed draft budget for the expenses of the Teacher-training college for 1970 is given in Table 14.

TABLE 14. Anticipated expenditure of the Teacher-training college for 1970

Kind of expense	Expense financed by the Special Fund		Expense financed by the Ivory Coast government (CFA francs)
	(US$)	(CFA francs)	
Foreign professors	(420 000)	105 000 000	15 784 000
Scholarships for Ivorian counterpart	(34 000)	8 500 000	
Native teaching staff			3 240 000
Administrative staff			2 776 000
Service personnel			4 200 000
Material and operation			5 600 000
Total	(454 000)	113 500 000	31 600 000

SOURCE Ivory Coast Ministry of national education, *Programme de formation de Maitres* (Teacher-training Programme), pp. 11, 12 and 15.

The current costs of the CAFOPs have been estimated as shown in Table 15.

TABLE 15. Current costs of centres for group leadership and teacher training

Year	CFA francs
1969	213 000 000
1970	225 000 000
1971	437 000 000
1975	462 000 000
1980	550 000 000

If the different programmes for training and re-training of instructors are carried out as planned, the number of new assistant teachers and full teachers can be forecast as in Table 16.

TABLE 16. Forecast of new assistant teachers and teachers joining the primary-school teaching staff from 1969 to 1974

	1969/70	1970/71	1971/72	1972/73	1973/74
Assistant teachers					
Re-trained assistant monitors			480		
Re-trained monitors		240	120	240	600
Graduates of CAFOPs	600	600	700	800	1 000
Total	600	840	1 300	1 040	1 600
Teachers[1]				65	65

1. No allowance is made for assistant teachers who are promoted to the grade of full teacher. Moreover, a section of the Dabou CAFOP is now training teachers who are secondary-school graduates, but they are being channelled towards the Advanced Teacher-training college to become teachers in secondary-general education.

By 1973/74 all the monitors and assistant monitors will have been re-trained; the primary-school teaching staff will then be composed exclusively of teachers and assistant teachers. Thereafter, the only sources of teacher training will be the Teacher-training college and the CAFOPS. It is calculated that the number of assistant teachers trained will be 1,100 in 1974/75 and will be stabilized at 1,300 starting with 1975/76.

This section has analysed the cost of the Ivory Coast government's decision to raise the qualification level of primary-school instructors. The following section discusses the cost of introducing television as a teaching medium.

III. Introduction of educational television and its effect on the cost of primary education

The introduction of television has a number of objectives: improvement in the efficiency of primary-school education, post-primary education, the further education and training of teachers already in service, and the provision of an effective cultural medium for adult education. The task assigned to educational television is therefore an ambitious one. Owing to the time required to install production centres and prepare the programme, the broadcast of the first televised courses to the schools will probably not begin until the school year 1971/72, so that at the present time the school television system is at the planning stage.

At this stage, three kinds of questions are of particular concern to educational planners. The first is whether the television method of teaching is justified in terms of the additional costs involved and the expected advantages, or whether some other solution might not be better. The second question is whether the television project is feasible considering its total cost, the available resources, and other

educational targets. Thirdly, proper planning is needed for the implementation of the various parts of the school television project.

This section will concentrate particularly on the cost aspects.[1]

A. Planning the introduction of television

It is useful to distinguish four aspects of educational television which demand separate planning: (i) technical; (ii) content and teaching; (iii) supporting communication and evaluation; and (iv) training provisions. All these have been separately planned in the Ivory Coast.

Technical requirements have already been carefully studied. A detailed analysis of the equipment to be used has been made with due consideration for conditions of climate, location of the schools (areas with or without electricity supply, terrain relief and relative distances from transmitters) and teaching requirements. The problem of the installation, maintenance and repair of television sets has also been examined. A time-table has also been drawn up, for determining the different stages of installation of the television network.

The preparation of the primary instruction programme and the determination of the content of the transmissions have been entrusted to the research section of the Teacher-training college. The Target Programme for the Ivory Coast school television system is summarized in Figure 2. As the chart shows, school programmes will be transmitted for ten hours each school day. The first hour before the children arrive will be devoted to transmissions for the instruction and guidance of the teachers; during the day there will be televised courses for the six grades of primary schools and the two 'grades' of post-primary informal education—and for an hour in the evening there will be a programme of educational television for adults.

Contact with teachers will be maintened by means of special transmissions for them and by sending them typed or printed instructions. Still closer contact will be established through the pedagogical advisers, who will be expected to visit each teacher once a month.

Programme evaluation will be carried out by means of a closed circuit connecting the Teacher-training college and a model CAFOP with the primary schools where the televised instruction is given. This closed circuit will make it possible to observe the reactions of the pupils to the school television programme. An evaluation on a broad scale is planned to be carried out after the school television system is actually in operation.

As has been said earlier, in order to provide training in the use of television for teaching staff, a four-week training course is planned for all teachers. It will be supplemented with television transmissions especially organized for them.

1. Other aspects of planning the introduction of school television are discussed in *The new media: memo to educational planners* by W. Schramm, P. H. Coombs, F. Kahnert and J. Lyle, Paris, Unesco/IIEP, 1967, which contains a series of recommendations for planning the introduction of new educational media.

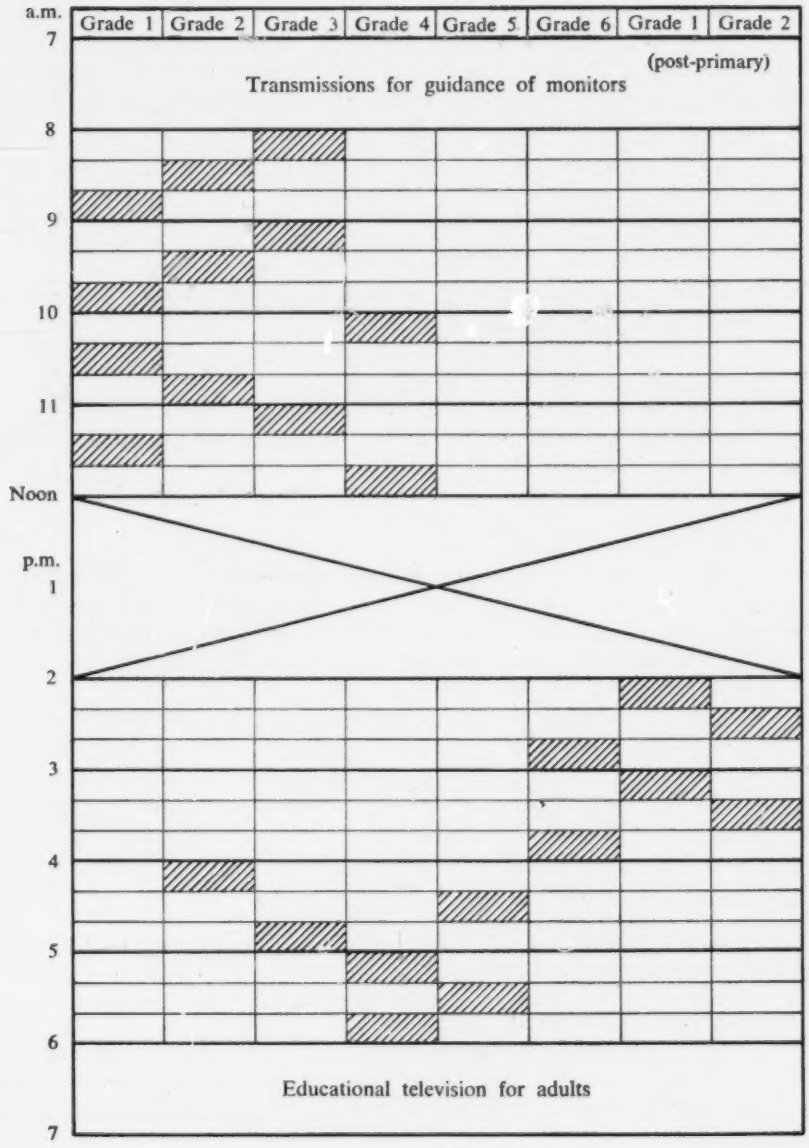

FIGURE 2. *Summary of transmissions by school television.*

For the technical personnel, a detailed plan has been established to send certain Ivorian personnel abroad for periods of technical training and to train others in the Ivory Coast. Under this plan, the number of foreign technical assistants—which will be relatively large during the first years of the operation of the programme—can be gradually reduced, and it is expected that after ten years all the foreign technical assistants will have been replaced by Ivorian personnel.

B. Evaluation of total costs of school television

A detailed estimate of the capital investment and operating costs during the first ten years of the programme has been made.

1. *Capital costs*

It is convenient to distinguish between the capital costs of production, transmission and reception.

(a) Capital costs of production

This capital cost covers the building and equipment necessary for the creation of a television production centre to prepare programmes for televised instruction.

Buildings. The production centre will include a programme preparation unit, a filming and recording studio and rooms for specialized work. The total cost of the centre has been estimated at 243 million CFA francs.

Equipment. The proposed equipment consists of six combined television camera units, two television film projectors (telecines), four camera tube still projectors for text material (combined video, sound and lighting units) and one order system. The cost of this equipment is estimated at 320 million CFA francs. The installation will be spaced out between 1969 and 1971.

(b) Capital costs of transmission

In 1967 the Ivory Coast public television system had three stations, each reaching an area within a radius of 100 miles. It is estimated that the area covered by these three stations includes two-thirds of the population of the country. A fourth transmitting station will be installed at Tanda.

At present, television programmes are regularly transmitted from 12.30 to 1.30 p.m. and from 7.15 to 10.30 p.m. If these programmes are kept within their present limits, it would be possible to use the free hours for school television, as shown in Figure 2.

The planned transmission of the school programmes implies that the television transmission equipment will be used extremely intensively — for 13 hours and 15 minutes every day instead of 3 hours 15 minutes, four times as much as now. If the televised instruction is to be extended to all the public schools, it would

probably be necessary to add still other stations to the transmission network in order to cover all parts of the country. However, the Plan contains no mention of any capital cost for further development of equipment or for extending the transmitting network, and any such expenditure seems to be left entirely to the Ivory Coast television system.

(c) Capital costs of reception

These capital costs consist mainly of the receiver equipment to be installed in the schools. One aerial per school, and one large-screen television receiving set per classroom seating forty-four pupils, are planned. As some parts of the country are without mains electricity supply, the Plan provides that 50 per cent of the television receivers should have their own power supply.

In order to avoid interruption of the televised instruction, a standby set will be provided for use in the case of a breakdown. Later, however, when more than one classroom in a school has been equipped, it will no longer be necessary to provide a standby set, since the programmes do not overlap in time and it will always be possible to switch pupils from one classroom to another in the event of temporary trouble with the equipment.

In determining the rate at which the televised method of instruction will be applied, it has been planned that the programme will begin in 1971/72 for the first grade. In that year, one-fifth of all first-grade classes will be equipped. The following year another one-fifth of all first-grade classes will be equipped, and at the same time an equivalent number of second-grade classes, so that the pupils who have begun their education with television can continue with it. This will be continued until all first-grade classrooms are equipped (1975/76), and after that until all primary-school classrooms are provided with television sets (1980/81).

The Plan estimated, in the light of population forecasts and trends in rural migration, that one-third of the primary-school enrolment will be in rural areas and two-thirds in urban or semi-urban areas (towns of over 1,000 inhabitants). This means that one-third of the pupils will attend three-room (rural) schools, and two-thirds will attend six-room (urban and semi-urban) schools.

The policy of gradually equipping all first-grade classrooms with television sets over a period of five years will be applied to both urban and rural schools. Enrolment in urban schools is assumed to be twice that in rural schools, but the rural schools receive first-grade pupils only in alternate years, and it will be necessary to equip sufficient classrooms in these schools to cater for a double entry (i.e., the equivalent of two years' first-grade entry). Thus, the number of first-grade classrooms to be equipped is the same in urban and rural schools.

The Plan assumed that in 1975/76, the total first-grade enrolment will be 105,000. Assuming the two-thirds to one-third ratio between urban and rural schools, this means that 70,000 first-grade pupils will enrol in urban schools and 70,000 pupils in rural schools (i.e. two years' entry). On the basis of forty-four pupils per class, this means that a total of 3,180 classrooms must be equipped, in urban and rural schools together, if all first-grade classrooms are to be equipped by 1975/76.

TABLE 17. Annual requirements for new television equipment, 1971-80

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
Six-room schools										
Antennas (aerials)	318	318	318	318	318	152	152	152	152	152
Television sets										
1st grade[1]	636	636	636	636	636	304	304	304	304	304
2nd grade[2]	—	—	—	—	—	—	—	—	—	—
3rd grade			318	318	318	318	318	152	152	152
4th grade				318	318	318	318	318	152	152
5th grade					318	318	318	318	318	152
6th grade						318	318	318	318	318
Total	636	636	954	1 272	1 590	1 576	1 576	1 410	1 244	1 078
Three-room schools										
Antennas (aerials)	318	318	318	318	318	152	152	152	152	152
Television sets										
1st and 2nd grades[1]	636	636	636	636	636	304	304	304	304	304
3rd and 4th grades[2]			—	—	—	—	—	—	—	—
5th and 6th grades					318	318	318	318	318	152
Total	636	636	636	636	954	622	622	622	622	456
Grand total each year	1 272	1 272	1 590	1 908	2 544	2 198	2 198	2 032	1 866	1 534
Cumulative annual total	1 272	2 544	4 134	6 042	8 586	10 784	12 982	15 014	16 880	18 414

1. Including one standby or emergency set.
2. No new installation due to use of standby set.

SOURCE Ivory Coast Ministry of national education, *Programme d'action*, op. cit., pp. 139-40.

Spreading this installation over five years means that 318 classrooms must be equipped each year in both urban and rural schools. After 1976, installation of new equipment for first-grade classes will be needed only for additional classrooms built as a result of population growth, although new installations will still be needed for subsequent grades, in order that all primary-school classrooms should be equipped by 1980.

The total annual requirements for new television equipment for the whole period 1971-80 are shown in Table 17.

If the planned time-table is adhered to, the equipment and installation costs will amount to between 130 and 230 million CFA francs a year.

In addition to the costs of installation of television sets in the schools, there is the related expenditure for maintenance and repair services. It is planned to establish the principal maintenance section at Abidjan, with six regional sections. These sections will be provided with the necessary material and equipment and also a vehicle pool, enabling them to inspect and install equipment in the schools.

The Plan also includes provision for the capital expenditure needed for replacing worn-out receiving sets. As the average life of a television set is five years, it is necessary to provide for the replacement of the sets five years after their initial installation.[1] It will not be until 1975 that the replacement cost of the set must be taken into account.

The total capital costs of school television can now be summarized in Table 18.

TABLE 18. Capital costs of school television in the Ivory Coast (in millions of CFA francs)

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Production										
Construction	243									
Equipment	172	118	36							
Transmission[1]	—	—	—	—	—	—	—	—	—	—
Reception										
Classroom equipment		130	128	152	172	232	196	192	178	160
Maintenance service		146	18	20	18	22	14	18	18	14
Replacement							112	112	138	156
Total	415	394	182	172	190	254	322	322	334	330

1. No estimate has been made for transmission investment. See pp. 34-35.

SOURCE Ivory Coast Ministry of national education, *Programme d'action*, op. cit., Annex 13.

2. *Recurrent costs*

As in the case of capital costs, we shall examine successively the recurrent costs relating to production, transmission and reception.

1. The more usual procedure is to include an allowance for depreciation in estimates of current expenditure. We shall see below that by neglecting this, the Plan under-estimates future unit costs.

(a) Production recurrent costs

The production unit will begin operations in 1970/71. The first year will be devoted to experimentation and study of the first-grade programme. The following year, the first-grade programmes will be transmitted and at the same time preparation of the second-grade programmes will get under way. The same procedure will be followed in subsequent years. Thus six years will be required to complete the programmes for all the primary-school grades. After that, programmes already produced could, if necessary, be used again, but this would mean the loss of one of the essential advantages of the television method, namely continuous adaptation of the instruction to meet new requirements. The Plan therefore provides for a *complete re-appraisal* of the instructional programme every six years.

During the first six years of operation, costs of the production unit will increase each year because of the necessity for re-examining former transmissions and making necessary adjustments to the programmes in the light of an evaluation of their results. Moreover, during that period certain initial costs must be met, such as the training of personnel and the provision of technical assistance to get the operation under way. When the foreign technical assistants can be replaced by Ivorian technicians, however, the costs will decrease considerably, as shown by Table 19.

TABLE 19. Recurrent costs of production (in millions of CFA francs)

Year	Production	Technical assistance	Total
1969/70	41	66	107
1970/71	157	161	318
1971/72	180	183	363
1972/73	194	194	388
1973/74	207	199	406
1974/75	213	205	418
1975/76	227	205	432
1976/77	204	184	388
1977/78	199	164	363
1978/79	196	99	295
1979/80	191	—	191

SOURCE Ivory Coast Ministry of national education, *Programme d'action*, op. cit., Annex 15.

When production costs have become stabilized, they will amount to about 200 million CFA francs per annum. However, as these costs do not depend on the number of pupils, the cost per pupil will decrease as the total number of pupils increases.

(b) Transmission recurrent costs

The recurrent costs of transmitting the school programmes consist of supplementary costs for the operation of the Ivory Coast radio-television system during the hours

devoted to broadcasting school programmes, that is the costs of power consumption, operation, supervision and maintenance. These costs will increase from 1971 to 1977 as the system expands after which they will be stabilized.

(c) Reception costs

The recurrent costs of the receiving network, which will be greater as the number of pupils increases, are much more difficult to forecast accurately because they depend heavily on the development of the various elements of school infrastructure (types of school and their distribution in the country) and the power supply for the receiving sets (mains or batteries). The power consumption must be included in the recurrent costs of reception, and also expenses for the upkeep of the equipment (spare parts and labour cost of emergency repairs) and for regular inspection and control service by a travelling team. Some of the costs of such technical infrastructure are, to a certain extent, independent of the number of classrooms equipped, which means that the unit cost for reception will depend on the number of pupils.

It is now possible to summarize the over-all structure of the recurrent costs of the Ivory Coast school television system (see Table 20).

TABLE 20. Summary of recurrent costs of school television (in millions of CFA francs)

Year	Production	Transmission	Reception	Total
1969/70	107	—	—	107
1970/71	318	7	—	325
1971/72	363	44	88	495
1972/73	388	50	119	557
1973/74	406	57	162	625
1974/75	418	63	209	690
1975/76	432	72	261	765
1976/77	388	77	326	791
1977/78	363	77	377	817
1978/79	295	77	424	796
1979/80	191	80	472	743

SOURCE Ivory Coast Ministry of national education, *Programme d'action*, op. cit., Annexes 14 and 15.

C. Additional costs and anticipated advantages of teaching by television

The introduction of television in the Ivory Coast will not have, strictly speaking, an experimental stage. Therefore the Plan advocated a number of studies to be carried out before the school television project is applied: (i) a study relating to the evaluation of experiments in the field of television and general educational technology; (ii) an inventory of basic research in child psychology; (iii) preparation of a curriculum for the Teacher-training college: (iv) preparation of a curri-

culum for the CAFOPs; (v) preparation in detail of primary curriculum; (vi) preparation of post-primary educational programmes.

However, such research has barely begun, so that it is not possible to make a cost/efficiency analysis of school television in the Ivory Coast. It is, nevertheless, useful to attempt to estimate the additional costs of teaching by television and to list its advantages without attempting to measure their real effects.

1. *Additional costs of school television*

The Plan estimated that the recurrent costs of school television will become stabilized, in 1979/80, at 200 million CFA francs annually, but before that time annual expenditures may reach as much as 432 million CFA francs, so that 2 million CFA francs is by no means representative of the costs during the period.

After costs become stable, however, the Plan estimates an annual cost of 80 million for transmission and a gradually decreasing cost of reception, which implies the unit costs shown in Table 21.

TABLE 21. Unit costs of televised instruction

	Number of pupils			
Kind of expenditure and units cost	50 000	100 000	500 000	1 000 000
Total expenditure in millions of CFA francs				
Production	200	200	200	200
Transmission	80	80	80	80
Reception	110	125	350	650
Total	390	405	630	930
Unit costs in CFA francs				
Production	4 000	2 000	400	200
Transmission	1 600	800	160	80
Reception	2 200	1 250	700	650
Total	7 800	4 050	1 260	930

SOURCE Ivory Coast Ministry of national education, *Programme d'action*, op. cit., p. 160.

In order to see the behaviour of the unit costs during the period of implementation of the Plan, however, it is preferable to calculate directly the total anticipated costs and the number of pupils who will be taught by the television method, as shown in Table 22 and Figure 3.

After 1978/79 the production and transmission cost per pupil/hour will become lower than the reception cost per pupil/hour. This raises the question as to whether it would not be cheaper to increase the number of hours of transmission rather than increase the number of television receiving sets. However, in the Ivory Coast, the total school television transmissions already planned cover eight hours each day. It is not possible to increase that total except by creating a second television channel, which would require a relatively large outlay of capital. Further-

TABLE 22. Total costs and unit costs of Ivory Coast school television, based on the number of pupils who will receive televised instruction

	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
Total expenditure									
(in thousands of CFA francs)									
Production	363 000	388 000	406 000	418 000	432 000	388 000	363 000	295 000	191 000
Transmission	44 000	50 000	57 000	63 000	72 000	77 000	77 000	77 000	80 000
Reception[1]	88 000	119 000	162 000	209 000	261 000	326 000	377 000	424 000	472 000
Total	495 000	557 000	625 000	690 000	765 000	791 000	817 000	796 000	743 000
Number of pupils	28 000	70 000	140 000	224 000	336 000	447 400	551 500	641 000	723 200
Unit cost									
(in CFA francs)									
Production	12 963	5 540	2 899	1 864	1 283	865	657	462	264
Transmission	1 571	714	407	281	214	172	139	120	110
Reception[1]	3 142	1 700	1 157	933	776	728	683	661	652
Total	17 676	7 954	4 463	3 078	2 273	1 765	1 479	1 243	1 026

1. Not including replacement of receiving sets.

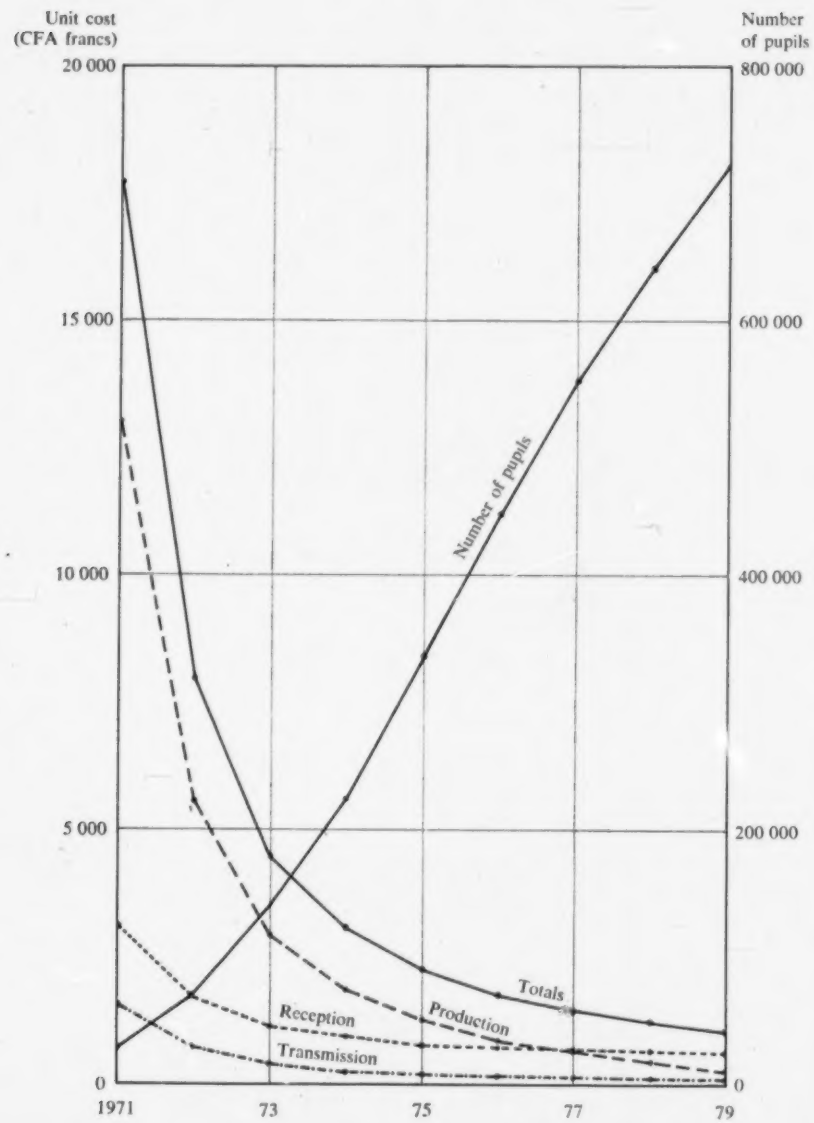

FIGURE 3. *Number of pupils to receive instruction by television and unit operation costs.*

more, the transmission costs so far considered are only marginal costs, representing the additional expense to the Ivory Coast television system of the transmission of the school programmes. If a second channel were created exclusively for school television, the entire cost would have to be attributed to the school television budget, which would make the unit cost of transmission much higher.

The target of the Ivory Coast government is to provide instruction by television for all primary-school pupils in the country. There is therefore no real choice between increasing the number of transmission hours or enlarging the audience. Enlarging the audience is the aim—at least until the entire primary-school enrolment is covered by this method of instruction.

Moreover, it is questionable whether it would be educationally desirable to increase the number of transmitting hours. According to the Plan each of the four grades of basic primary school will receive four 15-minute transmissions, totalling one hour of televised instruction, per day; in addition, the instructor must prepare the pupils for these transmissions, must develop the material and make sure that the essentials have been understood, and give the pupil exercises based on the lesson. The question therefore arises as to whether the pupils can properly absorb more than one hour of television a day.[1]

Nevertheless, there is scope for savings to be made in reception costs. The Plan provides for every classroom to have its own television receiving set. However, since each individual classroom set will be used for only one hour per day, it would be quite possible to arrange for one set to be used by an entire school— or rather, since provision must be made for an emergency such as breakdown of the receiver, a minimum of two sets will be necessary for each three-room school. Reducing the number of receiving sets from three to two would of course mean rotating the pupils, but it would seem possible, by careful arrangement of the hourly schedule of classes, to reap the maximum pedagogical advantage from the transmissions while keeping to a minimum the number of class rotations per day. Likewise, the number of receiving sets for six-room schools could be reduced from six to four. This possibility deserves at least to be closely examined, because it would make it possible to reduce the expenditure on receiving sets by one-third, and consequently the cost of replacing and operating them.

In all events, according to the installation time-table set up by the Action Plan for 1979/80, when the number of pupils receiving televised instruction reaches 720,000, the unit operating cost of school television will be 1,030 CFA francs. It appears that the unit costs is unlikely to fall below that level, partly because the rate of increase in pupils receiving televised instruction will decline after most of

1. By way of comparison, in the Samoan Islands the daily transmission times for the four grades of basic primary school are as follows:

First grade	1 h 35 mins.
Second grade	1 h 35 mins.
Third grade	1 h 50 mins.
Fourth grade	1 h 50 mins.

Source : *New educational media in action; case studies for planners*, Vol. I. Paris, Unesco: IIEP, 1967 (Table 3, p. 25).

the schools are equipped, and partly because at that stage the unit cost will consist mainly of reception costs, which cannot fall below a certain limit.

This estimate of cost does not take into account the fact that the receiving sets must be replaced every five years. If the replacement cost is included, the unit cost of televised instruction rises to 1,410 CFA francs.[1] On the other hand, the introduction of school television entails a change in the school supplies issued to the pupils. The action Plan estimates the additional unit cost of these supplies at 500 CFA francs. Thus, the additional per-pupil cost which can be attributed to school television will amount to 1,910 CFA francs.[2] In comparison with the present per-pupil cost of primary education (estimated at 13,500 CFA francs) this additional cost represents an increase of 14 per cent. The problem is to decide whether this increase of unit cost is justified by the advantages of instruction by television.

2. *Anticipated advantages of instruction by television*

The advantages of teaching by television must be assessed in terms of the aims of the Ivory Coast government which are, firstly, to reduce the effect of ill-adapted schooling, which causes rural migration (a factor detrimental to the economic development of the Ivory Coast) and, secondly, to increase the yield of the primary-school system.

(a) *Televised instruction and its effects on rural migration*

The problem of the effect of schooling on the population drift towards towns and cities is much too vast and too controversial to be discussed adequately here. We shall merely stress the fact that the Plan relies upon a re-appraisal and re-orientation of the educational content of the school programme to slow down the adverse effects of schooling on the location of population. An important role in this connexion will be played by the post-primary informal instruction given principally with the aid of television.

A re-appraisal of the programme implies, however, that the teaching staff must be capable of teaching the new subject-matter and altering the presentation of the retained traditional subject-matter. In other words, a certain amount of additional training is necessary for teachers. Instruction by television may meet this need, because the essentials of the new subject-matter will be presented in the form of televised lessons prepared by specialists. The instructor, or monitor, will simply need to develop these televised lessons, and he will be aided in this task both by the instructional leaflets which will be sent to him and by the special

1. For further details, see *infra*, p. 59.

2. It should be noted that in the absence of sufficiently detailed information it was not possible to assess (a) the cost of replacing the equipment of the production unit and of the repair service, nor (b) the increased training costs of instructors due to the introduction of teaching by television (equipping the teacher-training centres with electronic equipment, professors who have specialized in school television, etc.).

transmissions for his benefit. However, the effect of a total revision of the curricula, and hence the part played by television, can only be measured after a certain number of years of experience.

(b) *Televised instruction and improvement of educational yield*

The yield of primary education in the Ivory Coast is relatively low, and as we saw in Part I, 21 pupil-years are required to produce an elementary-school graduate and seven pupil-years are needed to produce one school-leaver who has completed the first four grades of primary school. There are various reasons for this low yield and several possible means of improving it. Instruction by television appears to be one way—but is it the best way from the standpoint of cost and efficiency?

The part played by television in improving educational yield is still a moot question, and educational authorities are far from being in agreement on the subject. There appear, however, to be a certain number of possible advantages: (i) a concentration of resources, making it possible to use the best teachers and teaching materials for the benefit of all pupils; (ii) the provision of visual aids which illustrate a subject, make instruction more concrete and more easily and clearly assimilated, hold pupils' attention, and avoid mere memorizing of abstract knowledge; (iii) the possibility of better planning of different subjects and hence a better integration of subjects.

But these advantages are potential, that is, theoretical at the moment; the real effectiveness of school television will naturally depend on the way in which the instrument is used. As things now stand, in view of the insufficiency of the studies and experiments in the Ivory Coast, it is not possible to judge in advance the extent to which school television will play a part in improving the yield of the primary education system.

In the preceding pages, we have endeavoured to show how the Ivory Coast Action Plan has forecast the effects of the improvement of teacher qualifications and the introduction of school television on educational costs. We shall now try to compare the total cost of the reform with the total resources which may be devoted to primary education, to see whether the reform is feasible from the point of view of necessary resources.

IV. Outlook for carrying out the reform of primary education: costing and financing

The estimation of the cost of introducing a reform is doubly useful from the point of view of educational planning. On the one hand, if the cost estimate is suffi-

ciently realistic and accurate and if it covers all the possible alternatives, it can serve as the basis for a rational and well informed choice between various solutions in the light of political and other restraints. At the same time, it will show whether or not the reform is feasible in terms of available resources. This section is concerned with this latter problem.

A. Trend of recurrent costs and outlook for financing them

In estimating recurrent costs for primary education, the Plan took as a base the average costs in 1967. It then estimated the effect of the different improvements in primary education on this average cost. The new estimate of cost was held constant thereafter and served as a basis for estimating the figures for the numbers of pupils who might be in school in 1975 and 1980.

Such a procedure can lead to a significant under-estimation of cost, as it is far from certain that costs can be kept constant, especially over such a long period of time. Moreover, the behaviour of the various components of cost may differ.

1. *Projection of the different components of the current cost of primary education*

In order to take into account the different behaviour of the various cost components and the main characteristics of the financing of primary education in the Ivory Coast, it is convenient to distinguish between the following costs:

(a) Cost of personnel
(b) Cost of classroom operation and supplies
(c) Cost of televised instruction
(d) Cost involved in subsidizing private schools.

In order to calculate the additional cost of the introduction of school television and the upgrading of teachers, some allowance must be made for extra expenditure on teacher training, even though the costs of teacher training are normally considered as costs of secondary or higher education. In fact the Educational Plan includes all teacher-training costs in the expenditure of the general educational system rather than in the costs of primary education.

(a) *Personnel cost*

In order to estimate the cost effect of upgrading teacher qualifications, the Plan took as a basis the distribution of teachers by qualifications in 1967 and estimated the difference in salary between assistant teachers and monitors and assistant monitors, calculating all salaries at a level 20 per cent higher than the starting-point of the salary scale.

This method is an inaccurate guide to future expenditure, for the following reasons:

1. The replacement of monitors and assistant monitors can only be carried out as they complete their additional training, and the increased salary cost will therefore be spread out over the training period.
2. This method makes no allowance for seniority of teaching personnel. For example, a monitor half-way along in his career may become an assistant teacher at the start of the salary scale when he has completed his additional training. Therefore, establishing *all* salaries at a level 20 per cent higher than the beginning salary tends to exaggerate the salary difference.
3. Moreover, the method does not take structural changes in the teaching force according to seniority into account; such changes depend on the rate of recruitment of new teachers, advancement in the career of those already engaged, numbers leaving the profession and numbers retiring.
4. The method allows only for variations in salary expenditure and ignores the costs of providing new teacher-training capacity.
5. Lastly, no account is taken of family allowances, bonuses and other benefits.

For all these reasons, we considered it preferable to proceed systematically, distinguishing between the following stages: (i) estimate of the distribution of each type of teacher by seniority, and changes in this distribution; (ii) estimate of total salaries, considering this distribution and the salary scale; (iii) estimate of other factors of salary costs (allowance etc.); (iv) estimate of possible real increases in salary costs (measured in constant prices).

(i) Structure of teaching staff according to seniority

The structure of the teaching staff by grade in 1966/67 and 1967/68 was as follows:

	1966/67	*1967/68*
Teachers	576	692
Assistant teachers	2 525	3 345
Monitors	1 618	1 735
Assistant monitors	1 032	718

In order to adjust the school year to the budget year, we have assumed that the budget for the fiscal year 1967 covered 8 months of the school year 1966/67 and 4 months of the school year 1967/68. With this adjustment, the number of teachers employed in the period of the 1967 annual budget becomes the following:

Teachers	615
Assistant teachers	2 798
Monitors	1 657
Assistant monitors	927

If the starting salary were assigned to each of these instructional categories, the total expenditure for salaries would be 2,405,480,000 CFA francs. However, the actual allocation for salaries of the primary-education teaching staff in the 1967 budget was 2,747 million CFA francs, that is 14 per cent more. Considering the

salary range and assuming that the difference between beginning salary and maximum salary is spread out over a period of 30 years, the average seniority of the teaching staff can be estimated at about 5 years above the starting-point of the salary scale. This estimate can obviously be only approximate—especially since we have taken the amounts allocated in the 1967 budget and not actual expenditure. Naturally, if data were available, it would be preferable to base the estimate on the real seniority of the teaching staff.

As we have seen, the number of new assistant teachers starting in primary education—including monitors completing their upgrading courses and those produced by the CAFOPs—will increase from 600 in 1968/69 to 1,200 in 1976/77.[1] Assuming that the annual rate of loss will be 2 per cent for teachers entering the profession during or after the school year 1968/69 and 3 per cent for those already active,[2] the distribution of the assistant teachers by seniority can be estimated as shown in Table 23.

TABLE 23. Projection of assistant teachers by seniority

Seniority	1967/68	1968/69	1969/70	1970/71	1975/76	1980/81
0		600	600	840	1 200	1 200
1			588	588	1 078	1 176
2				576	1 536	1 152
3					978	1 128
4					1 196	1 104
5	3 345[1]				756	1 080
6		3 244			528	968
7			3 144		516	1 376
8				3 043		873
9						1 066
10						672
11						468
12						456
13					2 542	
14						
15						
16						
17						
18						2 040
Total	3 345	3 844	4 332	5 047	10 330	14 759

1. This figure represents the total number of assistant teachers in 1967/68, at the average level of seniority. It has been assumed that the average seniority would increase by one year every year. That is not strictly true, because those going into retirement have longer seniority and their departure has the effect of lowering the average seniority. However, the teaching staff of the Ivory Coast is relatively young, and this factor may therefore be considered as having very little effect.

Available statistics do not enable the rate of loss to be accurately calculated, and the rates used must be considered as simply a working assumption. Neverthe-

1. See *supra*, page 31.
2. This difference in rate of loss is explained by the fact that teachers beginning their service in 1968/69 or thereafter will not retire during the period considered here.

TABLE 24. Alternative estimates of number of assistant teachers

Years	Total number of assistant teachers	
	By the previous method	Provided for in Action Plan
1970/71	5 047	5 300
1975/76	10 330	10 500
1980/81	14 759	15 000

TABLE 25. Composition of the teaching staff, 1967–80

Rating	1967/68	1970/71	1975/76	1980/81
Assistant monitors	718	480	—	—
Monitors	1 735	1 200	—	—
Assistant teachers	3 345	5 047	10 330	14 759
Teachers	692	822	1 018	1 189
Total	6 490	7 549	11 348	15 948

less, the results of this calculation are fairly close to the provisions announced in the Plan, arrived at by other methods (see Table 24).

Adopting the same procedure for the other categories of the teaching staff produces a similar estimate of their distribution by seniority. Table 25 shows the estimated composition of the total teaching staff by grade.

(*ii*) *Estimate of teachers' salaries*

In 1965 the salary scales for the different categories of teaching staff were as shown in Table 26.

TABLE 26. Salaries and bonuses, primary education (in CFA francs)

Rank	Function	Index	Salary		Functional bonus
			Minimum	Maximum	
Assistant monitor	Teaching	115–230	238 164	476 340	
Monitor	Teaching	165–180	341 736	591 876	
Assistant teacher	Teaching	210–375	434 904	776 628	
	Principal of primary school	—	—	—	2–3 cl. 36 000
		—	—	—	5 cl. 72 000
		—	—	—	6 cl. or + 108 000
	Teaching in school	—	—	—	108 000
	Principal of school	—	—	—	108 000

TABLE 26. Continued

Teacher	Teaching	315–675	652 368	1 408 284	
	Principal of primary school	—	—	—	2–3 cl. 36 000 5 cl. 72 000 6 cl. or + 108 000
	Teaching in school	—	—	—	
	Principal of school	—	—	—	180 000
	Pedagogical adviser	—	—	—	180 000
	Primary-school inspectors	—	—	—	264 000
Primary-school inspectors		405–1100	838 752	2 278 092	

SOURCE *Programme d'action*, op. cit., p. 56.

TABLE 27. Total salaries of different ranks of teaching staff (in thousands of CFA francs)

Rank	1970/71	1975/76	1980/81
Assistant monitors	144 804	—	—
Monitors	490 128	—	—
Assistant teachers	2 579 750	5 214 050	7 678 370
Teachers	668 081	878 808	1 078 517
Total	3 882 763	6 092 858	8 756 887

Assuming that the difference between minimum and maximum salary is spread out over a period of 30 years, the teaching staff costs can be calculated on the basis of the distribution of staff according to seniority, assuming that the salary scale remains fixed. The result of this calculation is shown in Table 27.

(*iii*) *Estimate of other factors in salary costs*

Table 27 shows only teachers' salaries, and does not take into account bonuses and family allowances. In the national budget for 1967, the funds allocated for salaries and other emoluments for primary school teachers were as follows:

	(in CFA francs)
Salaries and promotions	2 747 000 000
Family allowances	310 000 000
Retirement and sick fund	1 800 000
Bonuses, etc.	80 000 000
Total	3 138 800 000

Assuming that other factors as a proportion of salary costs remain at the 1967 level of 14.2 per cent of actual salaries, the salary amounts in the table must be corrected as follows:

	(in thousands of CFA *francs)*		
	1970/71	*1975/76*	*1980/81*
Salary	3 882 763	6 092 858	8 756 887
Other benefits	551 352	865 186	1 243 477
	4 434 115	6 958 044	10 000 364

(*iv*) *Estimate of possible increases in salary costs*

According to the Planning ministry, the *per capita* Gross Domestic Product (GDP) of the Ivory Coast will develop as shown in Table 28.

TABLE 28. Development of the *per capita* GDP

Year	GDP (millions of CFA francs)	Population (in thousands)	*Per capita* GDP	
			Amount in CFA francs	Index
1967	250 500	4 371	57 309	100.0
1970	317 000	4 630	68 466	119.4
1975	470 000	5 380	87 360	152.4
1980	636 000	6 260	101 597	177.2

SOURCE *Programme d'action*, op. cit., p. 169.

Assuming that teachers' salaries will keep pace with the growth of the *per capita* GDP, the personnel costs of primary education should be adjusted as follows:

	(in CFA *francs)*				
1970/71	4 434 115 000	×	1.194	=	5 294 333 000
1975/76	6 958 044 000	×	1.524	=	10 604 059 000
1980/81	10 000 364 000	×	1.772	=	17 720 645 000

This rapid increase in personnel costs is due to the fact that the anticipated increase of the GDP in the Ivory Coast is very rapid. The annual rates of increase are expected to be

Period 1967–70	8.1 %
Period 1970–75	8.2 %
Period 1975–80	6.2 %

The annual rate of population growth, on the other hand, is estimated at 3 per cent.

It is of course by no means inevitable that salaries should keep pace with the increase of the *per capita* GDP and it is quite possible that salary increases will be kept within stricter limits. It could be assumed, for example, that the rate of salary

increase will be only 2.5 per cent per annum, in which case the personnel costs will develop as follows:[1]

	(in CFA *francs)*			
1970/71	4 343 115 000	×	1.0769	= 4 775 098 000
1975/76	6 958 044 000	×	1.2184	= 8 477 681 000
1980/81	10 000 364 000	×	1.3785	= 13 785 018 000

(b) Costs of supplies

The trend of per-pupil expenditure on classroom materials and school supplies during recent years is shown by the following figures:

	(in CFA *francs)*		*(in* CFA *francs)*
1961	1 190	1964	1 320
1962	1 439	1965	1 147
1963	1 244	1966	1 627

The Plan, however, considered that the school supplies provided at present are definitely inadequate and should be increased by an additional expenditure of approximately 500 CFA francs per pupil per annum.

Although there has not been a definite trend in expenditure on school supplies during recent years it seems reasonable to assume that this item of expenditure will amount to about 2,000 CFA francs per pupil.

On the basis of the number of teachers available, and assuming a pupil/teacher ratio of 44:1, the number of student can be estimated, and from this the total cost of school supplies and classroom materials, as follows:

	Cost (in CFA *francs)*
1970/71	664 840 000
1975/76	989 208 000
1980/81	1 382 292 000

(c) Costs of educational television

Here, it is appropriate to distinguish between costs of Technical Assistance personnel, costs of Ivorian personnel, and costs of materials and supply.

(i) Costs of Technical Assistance personnel (Table 29)

Two kinds of Technical Assistants are provided for—experts, and French national servicemen who volunteer for technical co-operation work in place of military

1. In the calculations which we have shown, we have not allowed for the problem of school inspection or 'pedagogical control'. Pedagogical advisers are recruited from among teachers. The implementation of the advisory system could therefore be considered not as an increase in personnel expenditure but as a reduction in the number of full teachers available for actual teaching. In all events, the total number of full teachers available depends on the output of the Teacher-training college.

TABLE 29. Personnel cost of Technical Assistance (in thousands of CFA francs)

Year	Experts	Servicemen	Travel expense	Total
1969/70	63 200	—	7 850	71 050
1970/71	139 650	2 500	18 500	160 650
1971/72	148 350	12 600	21 100	182 500
1972/73	152 500	18 500	22 650	193 650
1973/74	150 150	25 100	23 700	198 950
1974/75	150 100	30 200	24 550	204 850
1975/76	150 100	29 400	24 350	203 850
1976/77	139 750	22 700	21 300	183 750
1977/78	130 500	14 250	19 300	164 050
1978/79	82 450	5 000	11 350	98 800

SOURCE *Etude technique d'une télévision scolaire en Côte-d'Ivoire* (Technical study of school television in the Ivory Coast Republic), p. 89.

service. The personnel cost in the case of the expert Technical Assistants is estimated on the basis of salary levels in France, adjusted to the cost of living in the Ivory Coast. Expatriation and travel allowances have been included in the estimate, as well as a regular salary increase of 2 per cent per annum. The servicemen's pay has however been held at the level of 15,800 French francs per annum or 840,000 CFA francs.

(*ii*) *Cost of local personnel* (Table 30)
Salaries for native personnel have been estimated on the basis of salary scales for public servants in the Ivory Coast or salaries paid by the Ivory Coast Radio-Television system. The salary scale is assumed constant, except for a salary increase for every four years' seniority.

TABLE 30. Personnel cost, local personnel (in thousands of CFA francs)

	Production	Transmission	Reception	Total
1970/71	66 000	7 100	2 420	75 520
1975/76	84 000	27 000	64 200	175 200
1980/81	93 000	28 100	101 000	222 100

Assuming, as before, that the salary scale increases 2.5 per cent per annum, the above figures should be adjusted as follows:

(in CFA *francs)*

1970/71	75 520 000	× 1.0769	=	81 327 000
1975/76	175 200 000	× 1.2184	=	213 463 000
1980/81	222 100 000	× 1.3785	=	306 165 000

(*iii*) *Cost of materials for educational television* (Table 31)
The cost of materials has been estimated on the basis of the present price level. Projecting into the future in terms of constant prices, the same estimates can be

TABLE 31. Cost of operation and supply (in thousands of CFA francs)

	Production	Tansmission	Reception	Total
1970/71	91 000	—	—	91 000
1975/76	143 000	44 700	218 800	406 500
1980/81	108 000	51 000	440 000	599 000

used for the entire period, although it is possible that the prices of electronic equipment and electric power (mains or battery), which are a major factor in this item of cost, may be lower in comparison with other prices.

It should be noted, however that the Plan has not charged the cost of replacing the television sets against operating cost but against the capital outlay. We shall refer to this point again when analysing the capital cost.

(d) Subsidy of private schools

In 1967 the subsidy granted by the Ivory Coast government to private primary schools amounted to 581,300,000 CFA francs. The Plan does not specify future policy concerning private schools— particularly in regard to the introduction of instruction by television. It is not known whether there will be a co-existence of two systems—public education using television and private education using more traditional methods. If is of course possible that instruction by television will be generalized to include private schools, in which case it will remain to be seen to what extent the government will participate in the cost of equipping the private schools and training their teachers.

In the absence of information, we shall assume that such subsidies will remain at their present level.

2. *Total recurrent costs of primary education and financial outlook*

It is now possible to summarize the total recurrent costs of primary education under the various assumptions of increased salary costs and compare them with the funds available for this sector of the educational system.

In the following analyses, we have excluded the cost of Technical Assistance personnel because this item may be financed by other sources than the Ivory Coast national budget.

According to the Educational Plan, the funds earmarked for primary education are as follows (in CFA francs):

1970/71 5 000 million
1975/76 9 300 million

However, as we have seen, part of the cost of primary education—including inspection and school supply costs—is charged to the general budgetary item

TABLE 32. Total recurrent costs of primary education under various assumptions (in thousands of CFA francs)

	1970/71	1975/76	1980/81
(a) *Assumption that salary scales will remain constant*			
Expenditure for personnel	4 434 115	6 958 044	10 000 364
Materials and supplies	664 840	989 208	1 382 292
Expense of televised instruction			
Personnel	75 520	175 200	222 100
Materials	91 000	406 500	599 000
Subsidy for private schools	600 000	600 000	600 000
Total	5 865 475	9 128 952	12 803 756
(b) *Assumption that salaries will increase 2.5 per cent annum*			
Expenditure for personnel	4 775 098	8 477 681	13 785 018
Materials and supplies	664 840	989 208	1 382 292
Expense of televised instruction			
Personnel	81 327	213 463	306 165
Materials	91 000	406 500	599 000
Subsidy for private schools	600 000	600 000	600 000
Total	6 212 265	10 686 852	16 672 475
(c) *Assumption that salaries will increase in proportion to per capita GDP*			
Expenditure for personnel	5 294 333	10 604 059	17 720 059
Materials and supplies	664 840	989 208	1 382 292
Expense of televised instruction			
Personnel	90 170	267 004	393 561
Materials	91 000	406 500	599 000
Subsidy for private schools	600 000	600 000	600 000
Total	6 740 343	12 866 771	20 694 912

'Pedagogical System' and if these sums are included, the real funds earmarked for primary education can be estimated at:

5 500 million in 1970/71
10 000 million in 1975/76
13 000 million in 1980/81

Comparing these figures with those in Table 32, we see that even if the salary scale is maintained at its present level, the financing of the Plan will involve certain problems in 1970/71.

These financing difficulties are not due to the introduction of televised instruction, as it is not until 1971/72 that it will really get started. The financing difficulties will arise from the relative increase in assistant teachers owing to the policy of upgrading monitors and assistant monitors.

The outlook seems better for 1975/76, provided that the salary scale remains constant. However, the figures we have given above are most likely to underestimate costs, for the following reasons: (i) the subsidy for private schools was arbitrarily fixed at the 1967 level; (ii) the expense of Technical Assistance was not included; and (iii) the cost of replacing television receiving sets was not taken into account.

The financing difficulties will naturally be still greater if the salaries of the teaching staff gradually increase—at an annual rate of 2.5 per cent for example—and especially if they keep pace with the *per capita* increase in GDP.

B. The trend of capital costs and the outlook for financing them

We shall examine successively the costs involved in the construction of classroom space, the development of teacher-training centres and the installation of the school television service.

1. *Construction of new classroom space*

No estimate has been made of expenditure for the construction of new classrooms and extension of the network of primary-school inspection offices necessary for the intensification of pedagogical supervision. This is because school buildings for primary education have so far been the responsibility of local authorities. In the Abidjan area, however, the construction of schools and also the construction of the primary inspection offices are financed out the national budget. In 1967 111 million CFA francs were allocated for that purpose in the national budget.

At all events, it is certain that in carrying out the Plan many new classrooms will have to be constructed because of the anticipated increase in enrolments. It is equally certain that the intensification of pedagogical supervision will entail extending the present network of primary inspection offices.

2. *Development of teacher-training centres*

Detailed estimates have already been given in Table 12. In addition, two new CAFOPs are to be created at Abidjan and at Man out of the capital cost of development of teacher-training centres. The total capital cost is estimated at 817,235,000 CFA francs.

3. *Capital outlay for school television system*

This outlay has been estimated in detail and a time-table has been established for spacing out the cost in time. The television receiving sets will have to be replaced every five years, and this replacement cost has been considered as a capital expenditure. Such a procedure leads, however, to under-estimating the magnitude of the replacement problem. According to the time-table for the first ten years of implementation of the Plan (1969–78) the capital costs will be as in Table 33.

The replacement of the television receiving sets thus appears as only 17.6 per cent of the capital expenditure. But that is due to the fact that the installation of the receiving sets only begins in 1971 and there will be no need for replacement until the beginning of 1976. Moreover, the number of sets to be installed in 1971,

TABLE 33. Capital costs of school television system (in millions of CFA francs)

	Expenditure	Percentage
Production		
Construction	245	8.2
Equipment	346	11.6
Reception		
Repair shops	277	9.3
Initial television sets	1 589	53.3
Replacement of television sets	523	17.6
Total	2 980	100.0

which will be due for replacement in 1976, is relatively low. As the new installations increase—and it is in 1975 that the new installations will be at the maximum—there will be a corresponding need for replacements five years later. For example, in 1981 it will be necessary to replace not only the 2,198 receiving sets installed in 1976 to expand the network but also the 1,272 sets installed in 1976 to replace the 1971 sets. The need for installation and replacement of television sets is estimated as shown in Table 34.

TABLE 34. Installation and replacement of television receiving sets, 1971–90

	New sets to be installed				
	in 3-room schools	in 6-room schools	Total	Sets to be replaced	Total installations for the year
1971	636	636	1 272		← 1 272
1972	636	636	1 272		1 272
1973	636	954	1 590		1 590
1974	636	1 272	1 908		1 908
1975	954	1 590	2 544		2 544
1976	622	1 576	2 198	1 272 ←	← 3 470
1977	622	1 576	2 198	1 272	3 470
1978	622	1 410	2 032	1 590	3 622
1979	622	1 244	1 866	1 908	3 774
1980	456	1 078	1 534	2 544	4 078
1981	456	912	1 368	3 470 ←	4 838
1982	456	912	1 368	3 470	4 838
1983	456	912	1 368	3 622	4 990
1984	456	912	1 368	3 774	5 142
1985	456	912	1 368	4 078	5 446
1986	456	912	1 368	4 838	6 206
1987	456	912	1 368	4 838	6 206
1988	456	912	1 368	4 990	6 358
1989	456	912	1 368	5 142	6 510
1990	456	912	1 368	5 446	6 814

By 1981, all schools will be fully equipped, so that new television receiving equipment will be needed only for new classrooms created to accommodate the increased enrolment due to population growth. On the other hand, replacement costs will increase from year to year, as shown in Figure 4. In 1981, for example, the cost will be 300 million CFA francs, and from 1986 onwards it will amount to more than 400 million CFA francs, assuming that the price of the sets remains the same. It should also be noted that if the production equipment needs to be replaced after ten years of operation, this replacement would also fall due in the year 1981, adding still more heavily to the expenditure.

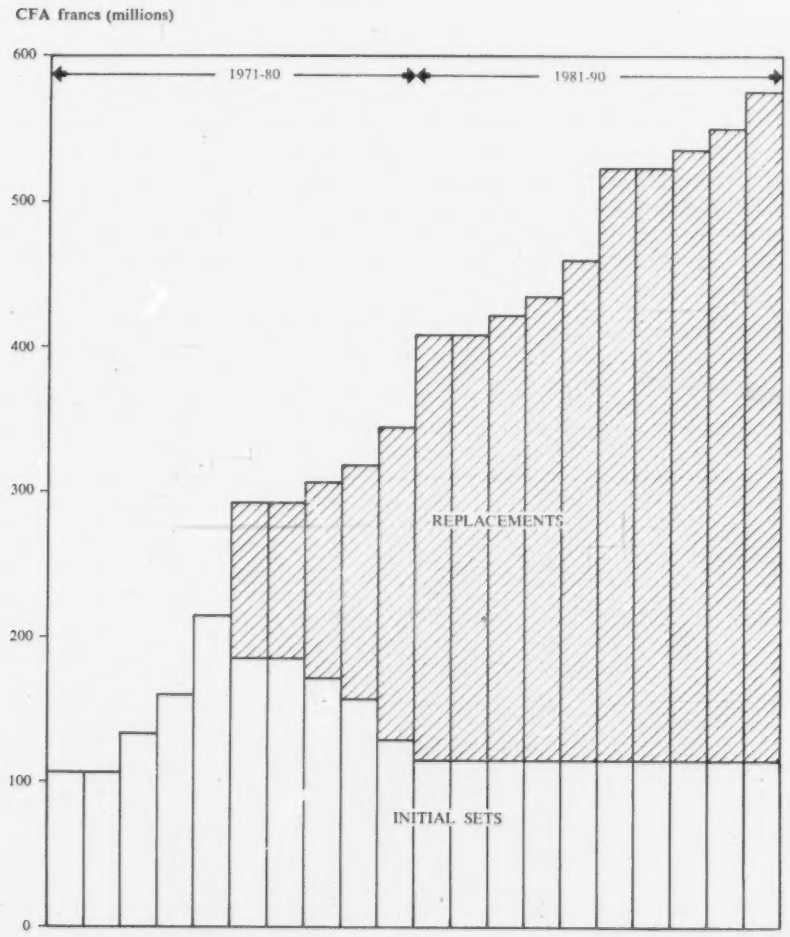

FIGURE 4. *Total costs of television receiving sets (initial sets and replacements)*

On the other hand, the fact that the replacement of the television sets is considered as an item of capital expenditure and is not included in the computation of the unit costs of school television under-estimates these unit costs to a large extent. The average cost of a television receiving set is 84,000 CFA francs.[1] If it is fully depreciated in five years, and assuming that the number of pupils per class is 44, the annual per-pupil cost of replacing the television sets is $\frac{84{,}000}{5 \times 44} = 382$ CFA francs. The unit costs shown in Table 21 should therefore be increased by 30 per cent or 41 per cent, depending on the number of pupils.

4. *Outlook for financing the capital outlay*

In the Educational Plan, no funds are earmarked specifically for the capital costs of primary education, since the construction of school buildings is mostly taken care of by the local population themselves. On the other hand, some funds are provided under a budget item for the entire educational system, mainly earmarked for increasing the number of CAFOPs, as follows (in millions of CFA francs) :

1968/69	350
1969/70	350
1970/71	350
1971/72	225
1972/73	225
1973/74	225
1974/75	225

It should be noted that according to the Plan capital cost of the development of teacher-training centres during the three-year period 1969–71 will amount to 817,235,000 CFA francs.

No provision is made in the Educational Plan for the capital cost of educational television. The Ivory Coast government expects that a part of the cost can be met by international organizations and bilateral assistance agreements, and has accordingly approached the World Bank in connexion with the construction of the Bouaké complex and of the CAFOP system. The equipment for the Teacher-training college may be provided by the United Nations Special Fund, which will also be asked to help in the establishment of a pedagogical research institute. The equipment for the CAFOPs, existing and to be constructed, will be financed by Unicef. French bilateral assistance may help towards meeting the investment cost for the production, transmission and reception of school television.

In view of the wide range of sources of financing and their still uncertain character, it is not possible at this time to judge whether the whole of the investment outlay set out in the Ivory Coast Action Plan can be financed in the future.

1. The price of a television receiving set operating on the public electricity supply is 55,000 CFA francs and 85,000 CFA francs for a battery-operated set. It is estimated that one-half of the school sets will have to operate on battery. The average cost is therefore 70,000 CFA francs. But for every ten sets installed it will be necessary to provide one standby set and the equivalent of another set in spare part assemblies for repair—so that the cost per installed set must actually be counted at 84,000 CFA francs.

Conclusions

Some general lessons for educational planners can be drawn from the Ivory Coast experience. The first relates to the contribution of an analysis of costs to a choice between alternative policies. The Ivory Coast government was faced with two choices: whether or not to introduce television as a means of instruction, and what level should be set for the qualifications of teachers. It was decided, as a matter of policy, both to introduce television and to improve the qualifications of teachers, in the hope of increasing primary-school efficiency. As a preliminary step in choosing this policy combination, the Ivory Coast government estimated the total cost of three possible policies regarding teacher qualifications, as well as the cost of introducing television.

Thus the estimation of costs helped in choosing between alternative policies. However, when cost estimates are used for such a purpose it is important to ensure that they are as accurate as possible. In view of the shortage of data it was necessary in the Ivory Coast Plan to make a number of simplifying assumptions about costs, but, as has been shown, some of these resulted in inaccurate cost estimates. For example, the method of calculating the saving in salary costs implied by a policy of employing less-qualified teachers resulted in an over-estimate of the saving, since the salary differential between qualified and less-qualified teachers was applied to the salaries of all teachers, rather than to newly recruited teachers only.

The case study also reminds us of the necessity of ensuring that cost estimates do not neglect any item of future expenditure. When estimating the increase in costs due to an upgrading of teacher qualifications it is necessary to include not only increased salary costs but also increased expenditure on primary-teacher training. Another omission was any allowance for depreciation in the calculation of future current expenditure. In view of the relatively short life of five years for television sets, it would be conceptually better to recognize that replacement of equipment will in the future represent a regularly recurring item of expenditure, and to calculate unit costs of television instruction with allowance for a steady annual rate of depreciation.

This case study serves to emphasize that the concept of cost adopted in a particular analysis depends on the objective of the analysis. In this case, all the cost estimates were made in terms of constant prices. This was quite adequate for the purposes of comparing the costs of three possible policies, but when it is necessary to estimate the future level of expenditure for implementation of the reform, some allowance should be made for future increases in prices, particularly in real salaries. Neglect of this can lead to serious under-estimates of future expenditure.

The assumptions that are made about future increases in unit costs affect the quantitative targets and the time-table set for the reform. In the case of the Ivory Coast, the quantitative targets were determined on the basis of constant unit costs. These quantitative targets—480,000 primary school pupils in 1975 and 720,000 in 1980—may therefore not be reached if unit costs increase. In the

context of a rapid growth of the economy and of the *per capita* GDP, it is probable that the salary costs will increase in real terms. The achievement of the qualitative and quantitative targets of the reform will therefore become hazardous in view of the financing limit of 13,000 million CFA francs set for 1980.

This raises the question of the financial feasibility of the reform. An analysis of trends in the different items of costs shows that financial difficulties may arise not so much because of the introduction of television, but because of increases in salary costs. Therefore if the future financial resources available for primary education are regarded as already determined, it will be necessary either to increase enrolments more slowly than was planned, or to slow down the policy of increasing teacher qualifications.

The alternative is to increase the resources allocated to primary education. One possible way is to increase government expenditure. Another way would be to find new sources of financing for the primary education system. At the present time almost the entire expenditure for primary education is financed out of the national budget. It is conceivable that in the future some degree of decentralization of financing could be achieved by means of increased contributions by local authorities and families. Such new sources of financing could relieve the national budget and facilitate the achievement of the targets.

In short, in judging the financial feasibility of an educational reform it is necessary to have the most accurate estimates of total cost, based on realistic forecasts of price changes, and also to consider all possible alternatives, regarding both patterns of expenditure and sources of finances.

Madagascar *12*

The role of cost analysis in the introduction and implementation of the 1962 reform of primary education

prepared by Ta Ngoc Châu, Jacques Hallak *and* Philip H. Coombs

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Introduction

Within the past decade or so, most developing nations of the world have set as one of their top priorities the attainment of universal primary education. This case study examines how one such country, Madagascar, went about pursuing this goal, what problems were encountered, and how cost analysis contributed to finding solutions. It is still too early to make any final assessment of this Malagasy effort, for it is still in process. In any event that is not the aim of this case study, its aim is simply to highlight some of the interesting lessons from the Malagasy experience, so that they may be useful to other developing countries engaged in the same quest for universal primary education.

Following the historic Unesco Conference of African Ministers of education in Addis Ababa in May 1961, and in the spirit of its recommendations, the government of Madagascar set a target for achieving universal primary education in 20 years.

Given the considerable effort already being made, it was evident to the authorities that this ambitious goal would not be economically feasible unless major changes were made in the existing approach to primary education. It was clear also that the effort would only be worth while if the content and methods of primary education were considerably revamped to fit the local needs and circumstances of Malagasy children, particularly in rural areas.

These considerations prompted the government to evolve the Malagasy Education Reform of 1962. This reform was incorporated into Madgascar's First Development Plan, covering the years 1964–68. Toward the end of this first plan period, as the Second Plan (for 1969–73) was being prepared, the Educational Planning Unit of the Ministry of education made three analytical studies which constitute the main sources of information on which the present case study is based.[1]

The first of these studies dealt with the cost of teacher training, the second with the financial implications of alternative rates of expansion of primary education, and the third with possible enrolment targets for the 1969–73 Plan.

By 1967/68 it was plain that the primary-school expansion programme, though it had made impressive progress, had encountered implementation troubles and was not on schedule. The studies by the Educational Planning Unit shed useful light on the reasons why and, more importantly, helped clarify the feasible options for the future.

1. Direction générale des services académiques, *Projet de plan d'opération pour un programme de recyclage et de perfectionnement du personnel enseignant*, Tananarive, 1967.
Bureau de planification de l'éducation, *Etude des besoins en maîtres de l'enseignement primaire en fonction des objectives du plan*, Tananarive, November 1967.
Ministère des affaires culturelles, Service de la planification de l'éducation : *Etudes préalables à l'établissement du deuxième plan quinquennal, Développements prévisibles dans les divers types d'enseignement en fonction des tendances du passé*, Tananarive, June 1968.
Other sources used are shown in the bibliography at the end of this case study.

The present case study is of particular interest because it highlights problems of implementing the goal of universal primary education which are common to a good many other developing countries; it shows once again the importance of possessing a certain minimum of facts essential to planning any major reform, to checking its progress and to modifying its course in the light of practical experience; and it suggests in particular how cost analysis can be useful in these matters.

For practical reasons we must limit our attention to those aspects of the story that relate directly to cost analysis, including a number of interesting methodological issues raised. We can give only passing attention to the important question of curriculum reform and to the vital matters of organization and administration that are fundamental to implementing any educational reform.

I. Features of the 1962 reform

The two basic aims of the reform, as noted above, were (a) to achieve a rapid expansion of primary education, consistent with the nation's economic means, especially in rural areas where the greatest gaps existed, and (b) to modify the character of primary education to fit local needs and circumstances.[1] Specifically, the 1964-68 Plan envisaged an increase in the ratio of primary enrolments to the school-age population (6–13) from 46.8 per cent in 1963/64 to 53 per cent by 1967/68, 75 per cent by 1972/73, and 100 per cent by 1982/83.

The three main features of the reform, apart from the curriculum aspects, were (1) the division it made between two types of primary schools—the traditional six-grade school and the 'first-cycle' four-year school; (2) the changes it made in teacher training and teacher qualifications, geared to these two types of schools; and (3) the changes it made in financing primary education, also geared to the two types of schools.

The balance of this study will make frequent reference to the above three features of the Malagasy reform, hence it is important to have them clearly in mind at the outset.

1. A ministerial decree of 23 September 1966 set the following guidelines for the new curriculum: (1) a new orientation of primary education which should be more practical, more related to the day-to-day life in rural areas; (2) more intensive use of the indigenous language, Malagasy, with French introduced only in the second grade as a foreign language; (3) more hours of practical and manual work; and (4) greater emphasis on certain aspects of social and economic development.

Since the new curriculum was not articulated until late 1966, this meant that teachers trained in the meantime would need to be re-trained to deal with it effectively. We will not attempt here to examine the financial aspects of the in-service training programme that was evolved, since finance was not a main consideration.

A. Two types of primary schools

The Malagasy educational system was patterned after the French system. Traditional primary schools of six grades existed largely in urban and semi-urban areas, where school attendance was relatively high. In rural areas, where the great majority of young people lived and where school attendance rates were much lower, the typical primary school, if one existed at all, had only four grades. If a rural youngster was lucky enough, he might finish four grades near home, then transfer to an urban school (perhaps living with relatives) to complete the final two grades—but this was rare. For the system as a whole the teacher/student ratio was very high (averaging one teacher for 88 pupils), repetitions of grade were frequent, and drop-out rates were also very high. (Of every 1,000 pupils admitted to the first grade approximately 420 reached the fourth grade and only 104 completed all six grades).

Since it seemed clearly out of the question to provide full six-grade schools for all parts of the country within 20 years, the reform called for the creation of four-year 'first-cycle' schools as an interim goal.[1] It was hoped that with improved teacher training and the new curriculum, every child could attain a useful basic education within this period, with some going on for more.

B. Two new types of teacher training

Before the reform, primary schools were staffed largely by 'Grade C' teachers and 'assistant teachers'. Grade C teachers had a total of 11 years of preparation; they were recruited from primary-school leavers (six years) through a selection examination; then they attended a teacher-training school (*collège normal*) where they were given four more years of general education and one year of pedagogical training. Assistant teachers had ten regular years of general education (six primary, four secondary) but had no special pedagogical training. The reform provided for the following important changes:

1. *First-cycle teachers* (for four-grade schools) would be recruited from students who had completed six years of primary school plus three years of general secondary education, and then given one year of pedagogical training at a new type of first-cycle teacher-training Centre (*Centre de formation pédagogique du premier cycle*). Three points are of special interest here. First, the selection test for first-cycle teachers would be aimed at judging the candidate's attitudes (open-mindedness, adaptability to a rural environment, dynamic outlook) rather than his level of academic knowledge. Second, the centres were to be

1. Other nations, now much more developed, also elected to start universal education modestly, then raise the level as their economic means and teacher supplies permitted. For example, compulsory universal primary education was initiated in the U.S.S.R. in 1930 with only four grades. By 1949, seven years of universal compulsory education had been substantially accomplished throughout the country. Currently, the U.S.S.R. is in process of implementing ten years of compulsory education.

located in rural areas and no more than forty students were to be trained at any one of them. Third, the one-year programme was to have four main parts: (a) general education (Malagasy, French, arithmetic, etc.), (b) simple and precise pedagogical training, (c) socio-economic training, and (d) information about agricultural extension services.

2. '*Grade C*' *teachers* (for six-grade schools) would hereafter be recruited from students who had completed ten years of general education (six primary plus four secondary), and would receive two years of training at a new type of second-cycle teacher-training Centre (*Centre pédagogique du 2e cycle*). The former *collèges normaux* (five years' duration) would gradually be transformed into these new-type institutions. This meant that Grade C teachers would now have a total of 12 years of preparation rather than 11, including two years largely of pedagogical training rather than one as before. The classification of 'assistant teachers' was to be abolished as rapidly as possible (to be replaced mainly by first-cycle teachers).

C. A new pattern of finance

Prior to the reform the overwhelming burden of financing primary education had fallen upon the six provincial governments, who on average, as of 1962, were devoting over 38 per cent of their total budget to this purpose.[1] Since the resources of the provinces were severely limited and their educational burden was growing rapidly, it was clear that an accelerated expansion of primary education could be accomplished only if more of the financial burden were shifted to the national and local governments (communes).

Under the reform, the traditional six-grade schools, including any new ones, would continue to be financed largely by the provincial governments. But all new first-cycle schools would be financed mainly by local governments (though with nearly 90 per cent subsidy from the national government for teacher salaries, and roughly 39 per cent subsidy for constructing and equipping new schools).

The practical effect of this was to continue the main burden for urban and semi-urban primary education (largely six-year schools) with the provinces, while the financial burden for new first-cycle schools, mainly in rural areas, would rest with local communities, aided by the central government. It also meant, very importantly, that the creation of new first-cycle schools would depend largely on local initiative.

1. In 1962, their aggregate total expenditures were 4,884 million FMG, of which 1,764 million went to primary education.

II. Potential economic advantages of the reform

Each of the above features of the 1962 reform had potentialities for reducing the economic obstacles to achieving universal primary education in Madagascar within 20 years. Four years of primary education in the first-cycle schools would obviously cost less than six years in the traditional primary school. Spreading more of the burden to the communes and the central government would lessen the strain on provincial budgets and help circumvent this financial bottleneck. The new arrangements for teacher training should cost less per teacher than the old system. Finally, the lower salaries for first-cycle teachers should reduce recurrent costs per pupil.

These evident economic advantages were a major factor in adopting the reform, though as far as we know no attempt was made at the time to estimate their actual magnitude. This happened only a few years later, in 1967 and 1968, when the Educational Planning Unit made its special studies. It is especially interesting for our present purposes to examine, in the light of these studies, the economies involved in the new teacher-training arrangements and the consequences for future recurrent costs.

A. Economies in teacher training

To make a valid comparison of teacher-training costs before and after the reform, it is necessary to include not only 'direct instructional costs' and 'scholarship costs' but the costs of 'wastage' as well.

Before the reform, as was said earlier, the preparation of a Grade C teacher (starting with six years of primary education) required five years in the *collège normal*, including four years of general education and one year of professional training. Because of the high rate of drop-out and repetition, however, it was established by the Educational Planning Unit that the real cost for those who finished these four years of general education was actually equivalent to 6.2 years. Adding all these elements together, as shown in Table 1, the estimated total cost of producing Grade C teachers *before* the reform (using 1966 prices) was 645,594 FMG per teacher.

The comparable figure *after* the reform was estimated to be 598,552 FMG per teacher. This may seem at first a surprisingly small 'saving' considering the reduction in the period of training and payment of scholarships at the *collèges normaux*, from five years to two years. One must remember, however, that in calculating the total *real* cost under the new programme, it is necessary to take into account: (1) the cost of four years of general education (in a regular secondary school), adjusted for wastage, *before* the future teacher enters the new second-cycle training centre; (2) the much higher fellowship stipend, comparable to a salary, in the second year of professional training (180,000 FMG as against 51,000 FMG in the first year); and (3) the fact that the new-

TABLE 1. Comparative unit costs of training teachers, before and after the reform (in FMG)

	Unit cost per year	Duration of cycle	Theoretical cost of cycle	Average duration	Real cost
A. Grade C Teachers — before reform					
General training					
Direct teaching	47 277	4	189 108	6.2	293 117
Scholarship	41 000	4	164 000	6.2	254 200
Professional training					
Direct teaching	47 277	1	47 277	1.0	47 277
Scholarship	51 000	1	51 000	1.0	51 000
Total			751 385		645 594
B. Grade C Teachers — after reform					
General training					
Direct teaching	44 032[1]	4	176 128	6.2	272 998
Scholarship	0		0		0
Professional training					
Direct teaching	47 277	2	94 554	2.0	94 554
Scholarship	115 500[2]	2	231 000	2.0	231 000
Total			501 682		598 552
C. 1st Cycle Teachers — after reform					
General training					
Direct teaching	44 032[1]	3	132 096	3.2[4]	140 902
Scholarship	0		0		0
Professional training					
Direct teaching + boarding cost	258 390[3]	1	258 390	1.0	258 390
Scholarship	51 000		51 000		51 000
Total			441 486		450 292

1. The unit cost of general secondary education is lower than the unit cost of teacher-training schools (47 277).
2. Rates of scholarships: 1st year, 51,000 FMG, 2nd year, 180,000 FMG, Total 231.000 FMG.
3. This unusually high cost is mainly due to a very low pupil/teacher ratio; the size in the centres being limited to 40 pupils.
4. The high difference between the average duration of general training of Grade C teachers and 1st cycle teachers stems from the fact that 1st cycle teacher candidates are selected among those who have had three years of secondary education while Grade C teacher candidates are selected among the *graduates* of the first stage of secondary education. The repetition rate is very high in Grade IV and the graduation rate is low.

type Grade C teacher would have a total of six post-primary years of preparation compared to only five years for the old type. These various factors are shown in Table 1.

The new 'first-cycle' teachers could be expected to be the least expensive of all to produce, since they would require only three years of post-primary general education (at a regular secondary school) and only one year of professional training at a first-cycle teacher-training college. The estimated real cost (in 1966 prices)

was 450,292 FMG. Here again the saving might seem less than expected; the reason is largely the very high instructional costs of the one year of professional training—258,390 FMG per student compared to 44,032 FMG for one year of secondary general education. This high cost of instruction resulted mainly from the decision to limit the size of these training colleges to only forty students, thus requiring a high teacher/student ratio and ruling out potential economies of scale. The components of the above estimate are also shown in Table 1.

We turn now to the implications of the reform for future recurrent costs of primary education.

B. Economies in recurrent costs

As of 1966, teacher costs represented an estimated 96 per cent of total primary-school recurrent costs in Madagascar (see Table 2); hence any reduction in teacher costs as a result of the reform would bring an almost proportionately equal reduction in over-all recurrent costs.

The ultimate potential for reducing future recurrent costs per pupil under the reform can be judged by the comparative salary figures shown in Table 3. As can be seen, the starting salary for first-cycle teachers was less than half that of assistant teachers (who were to be replaced by first-cycle teachers as rapidly as possible) and about one-third the salary of Grade C teachers. Roughly similar relationships prevailed at the midpoints and maximum points on the scales.

On the face of it, the potential for cost reduction seems enormous, but again one must not leap too quickly to conclusions. To obtain a valid estimate of the *actual* reduction, the following important factors must be considered. First, the new first-cycle teachers would have to be produced, and it would take time to produce a large number. Second, first-cycle teachers would replace more highly-paid assistant teachers or Grade C teachers only as rapidly as the existing ones

TABLE 2. Recurrent costs in public primary education, 1966 (in FMG)

Teaching personnel (excluding expatriates)	2 546 474	96 per cent
Teaching materials, etc.	105 240	4 per cent
	2 621 714	100 per cent

TABLE 3. Monthly salaries of different types of primary teachers (including family allowances), 1965/66 (in FMG)

Type of teachers (length of preparation)	Number in 1965/66	Minimum salary	Maximum salary	Midpoint
Grade C teacher (10 + 2 years)	743	28 950	50 580	39 765
Assistant teacher (10 years)	1 360	21 560	38 980	30 270
First-cycle teacher (9 + 1 years)	381	9 800	16 800	12 900

retired, resigned or died; meanwhile the existing ones would accumulate automatic salary increments for years of service. Third, it was envisaged that first-cycle teachers would teach *only* in first-cycle four-grade schools; how many such schools there would be depended on how many local communities took initiative to start them; in all events traditional six-grade schools (mainly in urban and semi-urban areas) would continue to be taught *at all grades* by the more expensive Grade C teachers, and there would be some increase in the number of such schools.

It is clear, then, that the 'savings', though by no means inconsequential, would be much smaller and much longer in coming than one might conclude simply by looking at the salary figures shown above.

The Educational Planning Unit did not attempt to make any over-all estimate of future savings in recurrent teacher costs, partly because they lacked the facts to do so. To make such an estimate one would need to know (or assume), among other things: (a) the age distribution of the existing teacher force (in order to gauge future salary increments, retirement rates, retirement payments, etc.); (b) the distribution of present and prospective primary-school enrolments as between four-grade and six-grade schools; (c) present and future pupil/teacher ratios by type of school; and (d) the rhythm of future production and hiring of new teachers, by categories. (Facts such as these are among the minimum essential ones required to plan and manage any educational system effectively. It is therefore well worth a considerable effort to establish a regular flow of such information.)

To sum up this particular section, the 1962 reform clearly provided considerable potential for easing the economic obstacles to achieving universal primary education in Madagascar within the time-frame set at Addis Ababa: (a) by limiting the initial goal to four years rather than six years of primary education; (b) by spreading the financial burden to three levels of government ; (c) by making possible the reduction of unit costs for teacher training and for operating the primary schools. How much of this potential would actually be realized, however, would depend on a number of factors, the most important being the rate at which local communities took initiative to start new first-cycle schools, the rate at which the production of new teachers—particularly first-cycle teachers—was expanded; and the rate at which additional six-grade schools were created in urban and semi-urban areas.

Five years after the 1962 reform was adopted, significant progress had been made, but at the same time, substantial impediments to its implementation had been encountered. We turn now to the record and problems of implementation.

III. Initial progress in implementing the reform

With the information available when this case study was prepared (1968–69), we can sketch the progress of the reform over the first three years of the 1964–68 Plan period.

A. Expansion of first-cycle schools

The Plan envisaged the construction of 2,511 new first-cycle schools by the end of 1968. On a straight-line basis, this would have meant about 1,500 by the end of 1966. In fact only 617 had been built by then, and it seemed doubtful that the full target would be met in the remaining two years.

There are, of course, many reasons for shortfalls in meeting school construction targets in developing countries, and no doubt a variety of these applied in some measure in Madagascar. One suspects, however, that one of the main causes in this case was the financial arrangements.

Under the reform, it will be recalled, the main responsibility for financing first-cycle schools was shifted to local communities, with provision for help from the central government. The estimated average capital cost of such schools was 500,000 FMG. The central government contributed 150,000 FMG of this amount, leaving the rest to local sources. In principle it was hoped that the equivalent of 200,000 FMG would be provided by voluntary local labour, leaving 150,000 FMG for the local government to supply.

As for recurrent costs (the bulk of which were teacher costs), the starting cost for a first-cycle teacher was 108,000 FMG, to which the central government contributed 89,000 FMG, leaving 19,000 FMG to be paid from local funds. The communes were expected to underwrite *all* teaching materials, estimated at 39,000 FMG *per class*.

Clearly these terms were feasible for many communes, as proved by the fact that over 600 schools were built. The available statistics leave some doubt, however, whether they were feasible, or at any rate sufficiently attractive, for poorer communities. Table 4 shows a wide variation by provinces in the progress made toward the 1968 construction targets by the end of 1966—ranging from a high of 42.7 per cent in Tananarive to only 8.8 per cent in Tulear (which also had the lowest school enrolment rate, 42.5 per cent).

Because of the low expansion of first-cycle schools, not surprisingly total enrolments in primary education were falling well short of the target. As of 1965/66, enrolments stood at 486,000, compared to a target of 515,000 for 1963/64 and 670,000 for 1967/68.[1] Apart from the lag in school building construction, another cause of this enrolment lag may have been the shortfall in production of first-cycle

1. These are the targets set in 1963 during the preparation of the first plan. In 1965, the projections were revised on the basis of enrolments in 1964/65 (see Table 8).

TABLE 4. Rate of enrolment and number of first-cycle schools built in the various provinces of Madagascar

Province	School-age population[1] 1966	Enrolment 1965/66 (Public and private)	Rate of enrolment	No. of schools to be built before the end of 1968	No. of schools built at the end of 1966	Percentage of the target
Tananarive	485 000	221 409	45.6	325	139	42.7
Fianarantsoa	379 000	175 000	46.2	680	246	36.1
Tamatave	253 000	108 859	43.0	386	92	23.8
Majunga	120 000	59 147	49.2	385	57	14.8
Tulear	144 000	61 300	42.5	545	48	8.8
Diego-Suarez	119 000	60 712	51.0	190	35	18.4
Total	1 500 000	686 427	45.7	2 511	617	24.5

1. 6 to 13 age group.

SOURCE School-age population: Bureau de planification de l'éducation, op. cit., Annex II.
Enrolment: SEDES, op. cit., p. 25.
Data about first-cycle schools: Direction générale des services académiques, op. cit., p. 5.

TABLE 5. Output of first-cycle teacher-training centres

Year	Number of centres	Annual output	Total number of first-cycle teachers trained
1962	1	33	33
1963	1	81	114
1964	6	99	213
1965	7	187	400
1966	7	220	620
1967	7	250	870
1968	7	277	1 147

teachers. The reform Plan called for 14 new training centres by 1972/73. The first was built in 1962 and a total of seven by 1966/67; but there was a shortage of candidates for them and these seven centres were operating below full capacity—with a total enrolment of 220 against a norm of 280 (7 × 40). Table 5 gives the teacher output picture up to 1968.

B. Over-all expansion of primary education

Table 6 gives an over-all view of public primary education, showing how the teaching force (by categories) and enrolments (by grade groupings) evolved up to 1965/66. It will be seen that grade V-VI enrolments (in traditional schools) had expanded significantly to 54,500 students, but this was well below a hoped-for number of 73,000 two years earlier (in 1963/64). Meanwhile little progress had been made in reducing the high pupil/teacher ratio. Though it is not shown in the

TABLE 6. Growth of public primary education to 1966

	1961/62	1962/63	1963/64	1964/65	1965/66
Teachers, Grade B	188	156	88	57	71
Teachers, Grade C	2 513	2 685	2 909	3 192	3 743
Assistant teachers	1 185	1 410	1 586	1 836	1 377
First-cycle teachers		33	114	213	381
Total	3 886	4 284	4 697	5 298	5 572
Enrolment					
Grades I to IV	307 596	344 874	382 991	409 061	431 942
Grades V and VI	29 553	36 228	41 506	45 523	54 481
Total	337 149	380 102	424 497	454 584	486 423
Pupils per teacher	86.7	89.0	90.4	85.4	87.3

SOURCES Teachers: Direction générale des services académiques, op. cit., Annex D and SEDES, op. cit., p. 30.
Enrolment: Bureau de planification de l'éducation, op. cit., p. 11 and SEDES, op. cit., p. 20.

table, there was little change in the output of new Grade C teachers, partly because the training colleges were making the transition from the old five-year to the new two-year programme.

As near as one can judge from the available data shown in Table 7, not much change had yet occurred by 1966 in the structure of enrolments by grade or in the high drop-out condition. There is a hint of progress in the figures given in Table 8, however, in the proportion of students going beyond the fourth grade, where the drop-out rate had previously been especially high.

TABLE 7. Enrolment structure by grades

	Actual enrolment			Enrolment in the first Grade reduced to 1 000		
Grade	1959/60	1961/62	1965/66	1959/60	1961/62	1965/66
I	105 255	131 238	172 000	1 000	1 000	1 000
II	68 501	80 005	116 200	651	608	674
III	44 678	56 354	84 300	424	428	489
IV	30 770	39 999	59 500	292	304	345
V	10 135	16 773	29 400	96	127	170
VI	6 694	12 780	25 100	64	97	145

TABLE 8. Original projections of enrolment targets for primary education

	1964/65	1965/66	1967/68	1969/70	1972/73
Total enrolment	633 000	719 900[1]	893 700	1 067 600	1 328 200
Private	178 500	185 800[1]	200 500	215 200	237 300
Public	454 500	435 100[1]	693 200	852 300	1 090 900

1. In reality, enrolment in 1965/66 was already a little different:
Total 686 427 Private 220 044 Public 486 423.

SOURCE Bureau de planification de l'éducation, op. cit., p. 2.

It would be misleading to place undue weight on the foregoing early evidences of progress—or the lack of progress—because the reform had thus far had little time to develop momentum. None the less, the gaps between performance and targets were properly taken by the governments as warning signals deserving investigation. Accordingly, the Educational Planning Unit was called upon to diagnose the situation, to test the feasibility of the earlier targets, and if necessary to propose alternative possibilities.

IV. A re-appraisal of the original targets

Were the targets set in 1963, to achieve universal school attendance by 1983, feasible? More particularly, would it be possible by 1973, the end of the Second Plan period, to boost the primary-school participation rate to 75 per cent?

The answer depended heavily on the answers to two other questions: Could enough teachers be trained? Could the financial requirements be met, especially by the provincial and local governments?

The matter was further complicated by yet another question: Would it be possible, in addition to meeting the enrolment targets, to raise the teacher/pupil ratio in the hope of improving quality and lowering the exorbitant drop-out rate?

The original targets had envisaged a constant annual enrolment increase in both public and private education of 86,900 pupils, as shown in Table 8.

(a) Teacher requirements. How many teachers would be required for this many students? The answer would depend on what teacher/pupil ratio was assumed. The Educational Planning Unit made calculations for four different ratios, ranging from 1:88 to 1:50, with the results shown in Table 9.

(b) Teacher supply. The next step was to project teacher supply, in order to see

TABLE 9. Teacher requirements according to different teacher/pupil ratios

Teacher/pupil ratio	1968/69	1969/70	1970/71	1971/72	1972/73
1 : 88	8 781	9 686	10 588	11 493	12 397
1 : 75	10 303	11 364	12 424	13 485	14 545
1 : 60	12 879	14 205	15 530	16 856	18 181
1 : 50	15 454	17 046	18 636	20 228	21 818

SOURCE Bureau de planification, op. cit., p. 3.

whether the above requirements could be met.[1] In making this calculation, the Educational Planning Unit allowed for an attrition rate between 1967 and 1972 among existing teachers equal to 5 per cent of the 1966/67 stock for first-cycle teachers (who were typically young) and 8 per cent for Grade C and assistant teachers (who were on average older and thus would have a higher retirement rate). With regard to the output of new teachers, it was optimistically assumed that all training institutions would be filled to capacity, all entrants would graduate, and all would enter the teaching force. The resulting projected teacher supply is shown in Table 10.

TABLE 10. Projection of teacher supply

	1968/69	1969/70	1970/71	1971/72	1972/73
First-cycle teachers	1 240	1 760	2 320	2 880	3 440
Other teachers	6 004	6 196	6 352	6 543	6 699
Total	7 244	7 956	8 672	9 423	10 139

(c) The teacher gap. A comparison of the teacher requirement figures (Table 9) with the teacher supply estimates (Table 10) quickly revealed a serious gap. To raise the teacher/pupil ratio to 1:50 would clearly be a formidable if not impossible task; the number of teachers needed by 1972/73 (21,818) would be more than double the estimated supply (10,139), leaving a deficit of 11,679. Even to maintain the present unsatisfactory ratio of 1:88 would leave a sizeable deficit (2,258) unless new training facilities were accelerated beyond what was then planned.

By the test of teacher supply, therefore, the feasibility of the original expansion target for 1972/73 was very doubtful. The Educational Planning Unit then turned to the test of financial feasibility.

(d) Cost and finance. The Planning Unit made relatively crude calculations to get a rough check on financial feasibility. Four methodological points about the analysis are worthy of note. First, they did not calculate *total* costs; they computed only the *additional* cost involved in reaching the enrolment target. Even then they did not include *all* additional costs. With respect to recurrent costs, they counted only teacher-training and salary costs, omitting teaching materials and other cost items (which, to be sure, were very small relative to teacher costs). They took no account whatever of capital costs. Thus their cost estimates were certain to be under-estimates.

Second, they made alternative cost calculations to match the alternative teacher/pupil ratio hypotheses used earlier in projecting teacher requirements. This would shed important light on the feasibility of improving the teacher/pupil ratio.

Third, they also made alternative calculations to match two different hypotheses

1. It should be noted that the government had by now decided to increase the planned number of first-cycle teacher-training centres to 19 from the earlier figure of 14, but the limit of 40 students per centre remained.

regarding the grades of teachers to be used in filling new posts: Hypothesis One, that all new posts would be filled by Grade C teachers only (the highest cost extreme), and Hypothesis Two, that new posts would be filled entirely with first-cycle teachers (the lowest cost extreme).

Fourth, they showed how the financial burden (of the *additional* costs only) would be distributed among the three levels of government, as an important aspect of the test of fiscal feasibility.

Teacher costs were defined to include both professional training costs and salaries. In the case of first-cycle teachers, the assumed training cost was 250,000 FMG (a much lower figure than shown earlier in Table 1). The assumed salary cost was the starting salary of a first-cycle teacher—108,000 FMG, divided between the central government (89,000 FMG) and local government (19,000 FMG). It was assumed that this salary would remain constant throughout the five-year period.

In computing the cost of additional second-cycle teachers, a professional training cost of 500,000 FMG per teacher was assumed (again well below the gross estimate shown in Table 1, but considerably above the estimate for the two years of professional training taken alone, exclusive of the cost of earlier secondary general education). The annual salary assumed was 320,000 FMG, the starting salary for a second-cycle teacher, paid entirely by the provinces, and this also was assumed to remain constant over five years. (Teacher salaries were in fact increased in January 1968, including an 11.69 per cent increase for second-cycle teachers.)

The resulting cost and financial projections are shown in Table 11(a) (all new posts filled with first-cycle teachers) and Table 11(b) (all new posts filled with Grade C teachers).

(e) Conclusions as to feasibility. These financial estimates, as we have seen, were crude and undoubtedly on the low side, yet they sufficed to clarify certain critical points.

First, at the high cost extreme, to fill all additional posts with second-cycle teachers, even at the unsatisfactory ratio of 1:88, would involve a *net cumulative addition* to present existing primary-school expenditures of 3,100 million FMG over the five years (not including capital and non-salary recurrent costs). This compares with *total* expenditures of 2,900 million FMG in 1966. Any such increase would impose such an enormous additional burden on the already strained budgets of the provinces that it could not be considered a feasible option.

Second, at the low cost extreme, if additional posts were filled entirely with first-cycle teachers, the added costs would be much lower (again with the above assumed teacher/student ratio of 1:88). Even so, a high rate of annual increase in the teacher-salary budget would be required, with the burden falling on the communes and the central government. Using the total primary-school salary costs of 1966 (2,700 million FMG) as a basis, the annual increase would range between 7 per cent (at a 1:88 ratio) and 36 per cent (at a 1:50 ratio). To this would have to be added the costs of teacher training (ranging from 564 million to 3,000 million FMG according to the teacher/pupil ratio assumed), plus all non-

TABLE 11. Added cost, and distribution of financial burden, of fulfilling the 1973 target (in FMG thousands)

(a) *All new posts filled with first-cycle teachers*

Pupils per teacher	Financing sources	Type of outlays	1969/70	1970/71	1971/72	1972/73	Total
88	Central government	Training					564 500
		Salary	153 970	170 524	184 230	200 962	709 686
		Total:					1 274 186
	Communes	Salary	32 870	36 404	39 330	42 902	151 506
		Total:					1 425 692
75	Central government	Training					1 101 500
		Salary	303 312	333 928	361 518	392 134	1 390 892
		Total:					2 492 392
	Communes	Salary	64 752	71 288	77 178	83 714	296 932
		Total:					2 789 324
60	Central government	Training					3 086 856
		Salary	556 161	610 362	661 537	715 738	2 543 798
		Total:					5 630 654
	Communes	Salary	118 731	130 302	141 227	152 798	543 058
		Total:					6 173 712
50	Central government	Training					2 919 750
		Salary	809 010	886 796	961 645	1 039 431	3 696 882
		Total:					6 616 632
	Communes	Salary	172 710	189 316	205 285	221 901	789 212
		Total:					7 405 844

(b) *All new posts filled with Grade C teachers*

88	Centr. Gov. Provinces	Training					1 129 000
		Salaries		613 427	662 731	722 921	1 999 079
		Total:					3 128 079
75	Centr. Gov. Provinces	Training					2 203 000
		Salaries		1 201 240	1 300 490	1 410 625	3 912 355
		Total:					6 115 355
60	Centr. Gov. Provinces	Training					4 021 000
		Salaries		2 195 657	2 379 749	2 574 727	7 150 133
		Total:					11 171 133
50	Centr. Gov. Provinces	Training					5 839 500
		Salaries		3 190 074	3 459 329	3 739 149	10 388 552
		Total:					16 228 052

SOURCE Bureau de planification de l'éducation, op. cit., pp. 7-8.

salary recurrent costs and all capital costs. It was at least very doubtful that many communes could afford such costs, even if the central government could afford its share.

In the light of the foregoing, it seemed clear to the Educational Planning Unit that even the lowest cost alternative for reaching the 1973 target (using only first-cycle teachers, at a teacher/student ratio of 1:88) was beyond the nation's financial reach.[1]

To sum up, the expansion target for 1973—to put 75 per cent of all children in primary school—had failed to meet either major feasibility test. Even under the most optimistic circumstances, with maximum acceleration in the expansion of training facilities, the teacher supply gap could not conceivably be filled before 1970/71, and even with a substantial increase in the rate of growth of the national economy and of public revenues, it would be extremely difficult at best to finance this large an expansion this quickly.

V. A fresh approach—starting with teacher supply

Faced with these stern findings, the Educational Planning Unit looked for an alternative approach not tied to the 1973 enrolment target. They hit upon the idea of starting with the prospective supply of teachers, which was, after all, the ultimate limiting factor to educational expansion. Starting with the teacher supply, they could calculate how many pupils this number of teachers could handle, then compute the costs and the distribution of financing by sources. Here is how it worked out.

1. *Future supply of teachers*

Using the same method as earlier but with more up-to-date data, the Educational Planning Unit projected the output and stock of teachers for each year up to 1974, broken down by the three main categories of teachers. The results are given in Table 12.

2. *Enrolment possibilities*

How many pupils could this number of teachers teach? To determine this was a simple matter of applying an appropriate teacher/pupil ratio. The ratio in 1966 was

1. At the time, the Malagasy GNP was growing at 3.7 per cent per annum, and approximately 19 per cent of the combined public revenues of the central, provincial and local governments was being spent on education.

TABLE 12. Projection of the supply of primary teachers[1]

Year	Second-cycle teachers	First-cycle teachers	Assistant teachers	Total
1966	3 710	411	1 576	5 697
1967	3 878	606	1 528	6 012
1968	4 196	850	1 491	6 537
1969	4 390	1 161	1 409	6 960
1970	4 584	1 459	1 379	7 422
1971	4 799	1 871	1 308	7 978
1972	5 080	2 355	1 280	8 715
1973	5 354	2 949	1 255	9 558
1974	5 624	3 650	1 232	10 506

1. This table is somewhat different from Table 9 due to more recent basic data used.

SOURCE Service de la planification de l'éducation, *Etudes préalables à l'établissement du deuxième plan*, Tananarive, June 1968, p. 53.

TABLE 13. Total possible enrolment in primary education, based on teacher supply

Year	Public	Private	Total	Enrolment rate[1]
1966	472 000	186 000	658 000	43.9
1967	499 000	193 000	692 000	44.9
1968	540 000	200 000	740 000	46.9
1969	575 000	206 000	781 000	48.2
1970	614 000	213 000	827 000	49.9
1971	656 000	221 000	877 000	51.6
1972	716 000	226 000	942 000	54.3
1973	783 000	235 000	1 018 000	57.5
1974	859 000	241 000	1 100 000	60.8

1. The enrolment rate has been obtained by dividing total enrolment (public and private) by the school-age population (6-13), as estimated by the Institut national de statistiques et de recherches économiques in 1966.

SOURCE Service de la planification de l'éducation, *Etudes préalables*, op. cit., pp. 5-6.

earlier thought to be 1:88, but the use of more accurate enrolment data reduced this to 1:82. Applying this revised ratio, the Planning Unit obtained the enrolment projects shown in Table 13, divided by public and private schools.

These enrolment levels implied a 60 per cent participation rate in 1974, against the original target of 75 per cent.[1]

3. *The financial implications*

It remained now to 'cost out' these new projections of teacher supply and enrolment to determine financial requirements and how these would be distributed among the three governmental levels.

1. It should be noted that the gap between these new projections and the original target resulted not only from the teacher shortage but from the fact that the youth population had earlier been under-estimated. Thus, if the new projections could be realized, the gap in absolute numbers would not be as great as the percentage differences in participation rates implied.

This time the Planning Unit were more thorough in making their cost estimates and no doubt achieved relatively more accurate results. They calculated *total* costs and not simply *additional* costs, capital costs as well as recurrent costs, and full recurrent costs rather than simply teacher costs. This gave a more comprehensive picture and a better basis for assessing financial feasibility.

Recurrent costs—six-grade schools. The method used was still very simple. They began with the breakdown shown below in Table 14 of recurrent expenditures by provinces on second-cycle (six-grade) schools in 1966.[1] (Provinces, it will be recalled, paid virtually the full recurrent costs of six-grade schools.)

TABLE 14. Provincial expenditures on second-cycle schools, 1966 (in FMG)

Teachers' salaries	2 467 400
Teaching materials	89 133
Contribution to the payment of expatriate teachers	107 912
Subsidy to private education	81 400
Total	2 745 845

Building upon the 1966 base, the Planning Unit added: (a) an amount per year equal to the number of additional second-cycle teachers, multiplied by an assumed average salary of 553,000 FMG (the midpoint salary in the Grade C teacher scale, adjusted for the January 1966 general salary increase); (b) a teaching materials allowance of 360 FMG per pupil. They assumed that the provincial share of payments to expatriate teachers, and contributions to private schools, would remain constant during the 1966–74 period.

TABLE 15. Projected educational expenditures by the provinces (mainly for second-cycle schools), in FMG thousands

Year	Teachers' salaries	Contribution to the payment of expatriates	Teaching materials	Subsidy to private education	Total
1966	2 467 400	107 912	89 133	81 400	2 745 845
1967	2 555 199	107 912	94 092	81 100	2 838 603
1968	3 040 537	107 912	103 479	81 400	3 333 328
1969	3 143 911	107 912	109 207	81 400	3 442 430
1970	3 248 000	107 912	114 933	81 400	3 552 245
1971	3 361 653	107 912	121 280	81 400	3 672 653
1972	3 511 296	107 912	129 575	81 400	3 830 183
1973	3 656 805	107 912	137 663	81 400	3 983 180
1974	3 800 196	107 912	145 634	81 400	4 135 142

SOURCE Service de planification de l'éducation, *Etudes préalables*, op. cit., p. 9.

1. Budgetary data were available for 1967 and 1968 but the Educational Planning Unit preferred to use actual expenditure data; for this, 1966 was the latest year available.

In this simple manner they reached the estimates shown in Table 15 for provincial educational expenditures up to 1974.

Recurrent costs—first-cycle schools. Essentially the same method was used for estimating costs for first-cycle schools, but in this case the financing would be shared between the communes and the central government. A constant teacher salary was assumed, equal to the starting salary for first-cycle teachers (108,000 FMG), and an allowance was made for teaching materials costs of 39,000 FMG *per class* (to be financed entirely by the communes). By this route the estimates shown in Table 16 were arrived at.

TABLE 16. Projected recurrent costs of first-cycle schools (in FMG thousands)

Year	Communes	Central government	Total
1966	23 838	40 227	65 065
1967	35 148	58 582	93 730
1968	49 300	80 298	129 598
1969	67 338	107 977	175 315
1970	84 622	134 499	219 121
1971	108 518	171 167	279 685
1972	136 590	214 243	350 833
1973	171 042	267 109	438 151
1974	211 700	329 498	541 198

SOURCE Service de planification de l'éducation, *Etudes préalables*, op. cit., p. 10.

Capital costs. The costs of school construction shown in Table 17 assumed: (a) an average cost of 865,000 FMG per classroom for a new second-cycle school, borne entirely by the province, and (b) an average cost of 500,000 FMG per first-cycle school, with 150,000 FMG contributed by central government and 200,000 FMG contributed in the form of voluntary local labour, and 150,000 FMG paid by communes.

TABLE 17. Projected capital costs of first- and second-cycle schools (in FMG thousands)

Year	Central government	Provinces	Communes	Total
1969	46 650	261 110	46 650	354 410
1970	44 700	258 940	44 700	348 340
1971	61 800	309 575	61 800	433 175
1972	72 600	388 275	72 600	533 475
1973	89 100	415 210	89 100	593 410
1974	105 150	443 850	105 150	654 150

SOURCE Service de planification de l'éducation, *Etudes préalables*, op. cit., p. 10.

Distribution of financial burden. By combining the foregoing cost estimates, it is possible to obtain the comprehensive picture presented in Table 18 of the total

TABLE 18. Projected expenditures on primary education by source of financing (in FMG thousands)

	1961		1966		1969		1974	
	Amount	%	Amount	%	Amount	%	Amount	%
Current expenditure								
State (first-cycle schools)			41 227	1.5	107 977	3.0	329 498	7.0
Provinces	1 580 297	94.6	2 591 489	92.2	3 289 136	90.9	3 981 848	85.1
Communes								
Contributions to the provinces	91 193		153 294		153 294		153 294	
First-cycle schools	—		23 838		67 338		211 700	
Sub-total	91 193	5.4	177 132	6.3	220 682	6.1	364 994	7.9
Total	1 671 490	100.0	2 809 848	100.0	3 617 795	100.0	4 676 340	100.0
Capital expenditure								
State					46 650	17.8	105 150	23.6
Provinces	35 097	100.0			167 810	64.4	233 550	52.8
Communes					46 650	17.8	105 150	23.6
Total	35 097	100.0			261 110	100.0	443 850	100.0

SOURCES 1961 : Service de planification de l'éducation, *Evolution des dépenses d'éducation à Madagascar*, Tananarive, December 1967.

1966, 1969, 1974 : Service de planification de l'éducation, *Etudes préalables*, op. cit., Tananarive, June 1968.

financial requirements, distributed by sources of funds, for achieving the Educational Planning Unit's new projected enrolments (based on their estimates of teacher supplies).

4. *Some conclusions*

The results of the foregoing analysis were presented to the Ministry of education and became the basis for preliminary decisions for the Second Malagasy Development Plan for 1969–73. So far as we know, the Planning Unit itself did not attempt to assess the over-all financial feasibility of these new projections, but they had presented their findings in such a form that this assessment could be made fairly easily by the appropriate economic authorities. In effect, the Educational Planning Unit had shown how much expansion would be *physically* possible (in terms of teacher supply) if the necessary financial resources were forthcoming. They had also shown the financial requirements and their distribution by sources.

Our account of what actually happened in Madagascar ends at this point (late 1968). It may be worth while, however, to consider two interesting questions on our own in the light of all the evidence presented: first, how successful had the reform thus far been, and was it likely to be, in its objective of re-distributing the

financial burdens of primary education? Second, to what extent had the potential economies of the reform been realized thus far and what were the prospects?

VI. Re-distribution of the financial burden

Prior to the reform, it will be recalled, the main financial burden of primary education fell upon the provinces, though the central government underwrote teacher-training costs and the communes made modest contributions to teacher salary costs. By 1962 the proportion of the provincial budgets going to education had reached 38 per cent and was still rising rapidly. Unless a way could be found to redistribute this burden, provincial budget limitations would clearly become a serious bottleneck to the further expansion of primary education (which had already expanded considerably since the late fifties). To meet this problem, the 1962 Education Reform relied primarily on first-cycle schools for further expansion and shifted the financial support of these schools to the communes, aided by the central government, leaving the continued support of second-cycle schools to the provinces.

To what extent was this shift of financial burden actually taking place by 1966, and what was implied by the revised enrolment projections with respect to future shift?

Table 19 traces the evolution of primary-education recurrent expenditures in Madagascar from 1961 to 1966, distributed by source of finance. Table 20 summarizes the 1961–67 trend of total provincial expenditures and the proportion of provincial budgets going to education.

We can see from Table 19 that by 1965 and 1966, thanks to a gradual rise in support of first-cycle schools by communes and the central government, the very high share contributed by provinces had begun to decline slightly. Table 20 shows that, despite this small decline in over-all percentage share, the proportion of tota' provincial budgets going to education was still rising—from 38.65 per cent in .962 to 51.00 per cent in 1966.

Had the targets for expanding first-cycle schools in the 1964–68 period been fully met, the percentage share of the provinces in over-all primary school costs would have declined more, *but not the absolute amount* of provincial contributions (to second-cycle schools). The latter figure is the most crucial measure of the real burden.

Returning now to Table 18, with its financial projections to 1974, we can calculate that the adoption of the Educational Planning Unit's revised enrolment projections would reduce the provinces' share of total recurrent costs for primary education from 94.6 per cent in 1961 to 85.1 per cent by 1964, and their share of capital costs from 100 per cent to 52.8 per cent. By this measure, at least, significant

TABLE 19. Primary education current costs and their respective source of financing (in FMG thousands)

Type of cost and financing sources	1961	1962	1963	1964	1965	1966
Teachers' salaries						
A. *Teachers and assistant teachers*						
Provinces	1 362 074	1 540 756	1 764 256	1 994 231	2 331 975	2 314 151
Communes	91 193	97 631	95 621	94 955	176 298	153 249
Total	1 453 267	1 638 387	1 859 877	2 089 186	2 508 273	2 467 400
B. *Expatriates*						
State			25 328	24 050		14 673
Provinces	12 041	31 743	60 769	60 845	115 128	107 912
Foreign Aid	350 000	275 000	295 000	306 491	283 991	303 991
Total	362 041	306 743	381 097	391 386	399 119	426 576
C. *First-cycle teachers*						
State		4 500	3 978	13 000	25 145	41 227
Commune				1 900	4 541	7 847
Total		4 500	3 978	14 900	29 686	49 074
Teaching materials						
Provinces	106 177	99 160	76 642	71 531	73 108	89 133
Communes				3 900	9 321	16 107
Total	106 177	99 160	76 642	75 431	82 429	105 240
Subsidy to private education						
Provinces	112 046	88 480	72 751	85 156	70 833	81 400

SOURCE Service de planification de l'éducation, *Evolution des dépenses*, op. cit.

TABLE 20. Total expenditures and educational expenditures of the provinces (in FMG millions)

	1961	1962	1963	1964	1965	1966	1967
Total expenditures	4 884	4 916	4 835	4 843	5 687	5 248	5 675
Educational expenditures	1 764	1 900	2 076	2 310	2 633	2 677	2 875
Percentage	36.12	38.65	42.84	47.69	46.30	51.00	50.65

progress would have been made by 1974 toward the reform's objective of redistributing the financial burden. But at the same time, the *absolute* financial burden of the provinces would have increased considerably, as shown by the following figures of annual rates of increase of provincial educational expenditures, actual and projected.

Period	*Current expenditures*	*Capital expenditures*
1961–66	10.4 %	21 %
1966–69	8.3 %	21 %
1969–74	4.0 %	7 %

Whether the provinces could afford such further increases is open to question. To be sure, the annual rate of increase declines substantially after 1969 (to 4 per cent as compared to 8.3 per cent in 1966–69, and 10.4 per cent before then). But this still exceeds the 2.6 per cent rate at which the provincial revenues had been growing from 1961 to 1967 and it implies a further growth in the percentage of total provincial budgets devoted to education—to something over 50 per cent.

What about the ability of the communes to finance their new share of the costs of first-cycle schools? If the Educational Planning Unit's revised projections are realized, by 1974 first-cycle schools will account for about one-third of total primary enrolments. This implies an annual rate of growth of educational expenditures by communes of 14.7 per cent from 1966 to 1969 and 11.9 per cent from 1969 to 1974. Clearly this is a heavy burden on local financial sources. One suspects that it may be a feasible burden in the earlier stages of the expansion, when richer communes and those most eager for schools are coming into the programme. But as the programme reaches the poorer and less enthusiastic communities, the going may get rougher and the creation of new schools may slow down (even if teachers are available).

The financial burden of primary education on the central government up to 1966 had been very modest (mainly teacher-training costs). But with the expansion of first-cycle schools, both the absolute and per cent share of the central government in financing primary education will increase fairly rapidly. A major point to bear in mind, however, is that although the central government will contribute to financing first-cycle schools, it can only do so *if* the communes themselves take the initiative to start a school. In principle the central government, under the financing policies of the reform, is not in a position to take initiatives of its own to accelerate the expansion of primary education (except by accelerating the expansion of teacher training to overcome teacher shortages). Sooner or later, if a substantial number of communes are either unable or unwilling to exercise their initiative, the central government may be required to take further action of its own, particularly to aid the poorest communities, if the goal of universal primary education is to be realized.

VII. Economies achieved by the reform

The Educational Planning Unit made no estimates of actual or potential savings resulting from the reform. To suggest how this might be done, the IIEP has made the following *illustrative* analysis. It should be remembered, however, that in this analysis certain arbitrary assumptions have been made for convenience which may be far from the truth, hence this illustration should *not* be regarded as a replica of the real situation.

In 1961, before the reform, the composition of the teaching force was: Grade C teachers 2,701, assistant teachers 1,185, giving a total of 3,886.

As a result of the reform, the evolution of the teacher stock would be considerably different than it would otherwise have been. The main difference is that first-cycle (less expensive) teachers would replace assistant teachers, and the emphasis on expanding first-cycle schools would lessen somewhat the relative role of the traditional six-grade (second-cycle) schools. One can reasonably assume, therefore, that if the reform had not occurred and there were no first-cycle teachers, assistant teachers would continue to be hired instead.

One can make the further very simple assumption (purely for the sake of illustration) that in the absence of the reform, there would be about as many Grade C teachers as *with* the reform, and that there would be as many assistant teachers as there would be first-cycle teachers *with* the reform.

Based on these assumptions the composition of the teaching force might evolve approximately as follows under the two alternative sets of conditions:

TABLE 21. Evolution of the composition of the teaching force with and without the 1962 reform

			1973/74	
	1961/62	1964/65	Without the reform	With the reform
Grade C teachers	2 701	3 249	5 624	5 624
Assistant teachers	1 185	1 810	4 882	1 232
First-cycle teachers		239	—	3 650
Total	3 886	5 298	10 506	10 506

Under the assumptions we have made, the total cost of primary education would be roughly as follows in 1974, with and without the reform.

TABLE 22. Comparison of total costs of primary education with the reform and without the reform in 1974 (in FMG thousands)

	With the reform	Without the reform
Teachers	3 199 563[1]	3 199 563
Assistant teachers	384 464[1]	1 296 524
First-cycle teachers	420 204[2]	
Teaching materials	287 984	287 984
	4 292 215	4 784 671
Expatriates	122 585	122 585
Subsidy to private education	81 400	81 400
Total	4 496 200	4 988 056

1. These figures are *not* those given by the Educational Planning Unit but those we have computed to take into account the length of service of teachers (the Educational Planning Unit assumed that the cost of an additional teacher is equal to the salary of a teacher at midpoint of the salary scale).
2. It has been assumed that the increase in salary is 2 per cent per year of service.

TABLE 23. Allocation of expenditures to the different financing sources in 1974 with and without the 1962 reform (in FMG thousands)

Type of expenditures	With the reform				Without the reform			
	State	Provinces	Communes	Total	State	Provinces	Communes	Total
Teachers		3 046 314	153 249	3 199 563		3 046 314	153 249	3 199 563
Assistant teachers		384 464		384 464		1 205 274	91 250	1 296 524
First-cycle teachers	346 248		73 956	420 204			—	
Teaching materials		145 634	142 350	287 984		287 984		287 984
Sub-total	346 248	3 576 412	369 555	4 292 215		4 539 572	244 499	4 784 071
Contribution to the payment of expatriate teachers	14 673	107 912		122 585	14 673	107 912		122 585
Subsidy to private education		81 400		81 400		81 400		81 400
Total	360 921	3 765 724	369 555	4 496 200	14 673	4 728 884	244 499	4 988 056

Two interesting conclusions can now be drawn, about savings and about the distribution of the financial burden.

The figures in Table 22 show that in 1974, 12 years after the reform was adopted, the estimated annual saving would be about 10 per cent. This may seem a small saving, especially in light of the wide salary spread between first-cycle teachers and Grade C and assistant teachers. But two important points must be remembered. First-cycle teachers are supposed to work only in first-cycle schools, not in the first four grades of second-cycle schools, and this seriously limits the scope for economy. Second, the reform accomplishes much more than reducing costs. It provides more professional training for teachers and presumably thereby makes them better teachers. It also reduces an otherwise impossible financial burden upon the provinces, thereby removing a major obstacle to the expansion of primary education.

To illustrate the last point we have set out in Table 23 our estimates of the comparative distribution of financial burden with and without the reform (still remembering that these are based on only *one* set of many possible assumptions). It shows that the reform reduces the share of the provinces by 1974 from 94.8 per cent of total primary-education costs to 83.7 per cent—or in absolute terms, from over 4,700 million FMG, to less than 3,800 million FMG. In this sense the reform will clearly give relief to the provinces. But the fact remains that under the reform (taking our illustrative assumptions) the *absolute* financial burden on the provinces will still rise from about 2,600 million FMG (in 1966) to nearly 3,800 million FMG (in 1974)—an annual growth rate of 4.8 per cent. This increase would be substantially less, of course, and the share of the provinces smaller, if first-cycle teachers were also used in the first four grades of second-cycle schools.

VIII. Some general lessons

Our purpose in examining the experience of the 1962 Malagasy education reform has been to learn useful lessons, not to pass judgement on the reform itself or on its implementation. In the preceding pages a variety of specific methodological and other lessons have been self-evident. Here we comment, by way of summary, on a few of the broader lessons. They cluster under two general headings: (a) usefulness and limitations of simple methodologies where facts are scarce; (b) the essential analytical steps in the strategy of an educational reform.

A. The use of simple methodologies

The Educational Planning Unit in Madagascar used simple, even crude, method-

ologies and assumptions throughout. This is not said in criticism; they had no choice in the matter, for the basic facts and technical manpower available were limited. The point is that in many such situations, simple methodologies, *used with sophistication*, can often provide important insights of great practical value to educational planners and decision-makers.

To illustrate: using simple methods, the Educational Planning Unit demonstrated beyond reasonable doubt that the original target for 1973 (75 per cent participation) was probably not feasible in that space of time, either financially or in terms of teacher supply, and that even a reduced target (60 per cent participation) would not be physically feasible without a more rapid expansion of teacher supply than was then planned. Using the data and projections provided by the Educational Planning Unit's studies, we found it possible also, using very simple methodologies, to show that the savings resulting from the reform, although substantial and critically important, were less than the casual observer might expect. We found also that even with the re-distribution of financial sources, the absolute burden on the provinces would continue to mount—possibly beyond their capacity to carry it.

It is equally important, however, to stress the *limitations* of simple, crude methodologies and the heavy handicap imposed by lack of essential data. In the present case, for example, the potential value of analysis suffered considerably from the lack of good information about the breakdown of total enrolments by grade levels and as between first- and second-cycle schools, about variations in teacher/pupil ratios by different types of schools and grade levels, and about the age and salary distribution of the teaching force. When the analyst is obliged to deal only in general aggregates and rough orders of magnitude, much of importance remains concealed. There is no substitute for establishing better information flows, and the investment involved can pay large dividends.

B. The role of analysis in the strategy of reform

Obviously much more than analysis is involved in designing a good educational reform and then making it work. Administrative and political skills are also needed, for example, to deal with problems of persuasion, of gaining understanding and co-operation, of arousing support and, not least of all, of actually getting things done. But analysis, including cost analysis, can make a crucial difference.

The first essential step begins before the reform is even adopted. A series of basic questions needs to be asked and answered as accurately and forthrightly as possible. What is the purpose of the reform? Is it the right purpose, the highest priority purpose? Assuming it is, then is the proposed reform really necessary to achieve this purpose? What are the problems that must be overcome? If some sort of reform is clearly necessary to overcome these problems, is this the right one? Or is there a better alternative?

To test any particular reform, one must ask: What are its implications—for

teacher requirements, financial requirements, administrative capabilities, etc.? On what critical assumptions does its success depend, and at what critical points is the reform most likely to break down? Suppose the reform succeeds, what then? What would be the logical follow-up?

The educational authorities of Madagascar obviously considered most of these questions. Their purpose was clear—to achieve universal primary education of a relevant sort as quickly as possible. Though we have no evidence that they actually analysed the implications for costs, finance and teacher supply in any systematic way, they clearly concluded that their purpose could not be achieved under the existing educational arrangements; thus there had to be a reform, a major innovation of some sort. The particular reform they chose clearly offered lower costs—though how much lower was a moot question. It also offered relief to the financially hard-pressed provinces—though, again, just how much relief was apparently not estimated. And it included provision for making elementary education more relevant to local needs, and for improving the professional training of teachers.

The important thing missing, it would seem, was a quantification of these critical factors—costs, finance and teacher supply—in relation to each other and within a clear time-frame. Such a quantification was not attempted until a few years later, in 1967 and 1968, when the Educational Planning Unit undertook the analytical studies which we have examined in this case study. By then the reform had run into difficulties and was running behind schedule.

It would be naïve to think that if more analysis had been done earlier (assuming this were possible, which it probably was not) these difficulties could have been averted. But on the other hand, it is not unreasonable to believe that some of the difficulties might have been more clearly anticipated—such as the lag in teacher supply and the lag in starting new first-cycle schools—with the result that remedial adjustments to correct them might have been initiated sooner. More importantly, if it had been possible before the reform was adopted to apply more rigorous feasibility tests (particularly as to finances and teacher supply) this might have altered somewhat the initial choice of targets and time-schedules and possibly other features of the reform.

This said, we must hastily add that few major educational reforms that we know of, whether in developed or developing countries, have ever been analysed *in advance* in the manner we are suggesting here. We can only hope that the time will soon come when this will be a matter of standard procedure for all well managed educational systems.

The second essential step, as soon as possible after the reform is launched, is to establish provisions for monitoring and evaluating its progress, regularly and systematically. Inevitably unforeseen problems and developments will arise that will affect the progress of the reform. The sooner these can be detected and diagnosed, the sooner they can be dealt with. A diagnostic system of this sort requires first of all the choice of a limited number of 'critical indicators' that will reveal progress—or the lack of it—at the most critical points. But to operate these critical indicators there must be an 'information system' which regularly supplies the necessary minimum flow of data on an efficient schedule.

If teacher supply is lagging behind expectations, if costs are rising faster than anticipated, or revenues more slowly, if there is beginning to be a severe geographic imbalance in the over-all pattern, or if enrolments have increased but drop-outs have also risen—in short, if any such untoward developments are occurring, it is important to know it as soon as possible. If left unattended long enough such problems may become unmanageable.

The third step, and the last we will mention, *is to begin evolving plans for the next plan period well in advance of its arrival.* This will be far easier if the provisions for Step Two have been well made. After all, a 'plan period' is simply an arbitrary slice of time used for convenience. Educational development, on the other hand, is a continuous process, and to be successful, educational planning and the analysis that goes with it must also be a continuous process, with ample latitude for adjustment all along the way.

The Malagasy case is especially illuminating in this respect because the analytical studies of the Educational Planning Unit were made *in advance* of the Second Plan. Though our story ends before the Second Plan got started, there is little doubt that it was destined to be a relatively sounder and more feasible plan as the result of these analytical efforts.

These general lessons and guidelines extend well beyond cost analysis alone, to such matters as the analysis of enrolments, teacher supply and requirements, school construction, curriculum, and financial patterns. This is as it should be, for cost analysis standing alone tells very little. Combined with other factors, however (in most cases, factors more familiar to educational administrators), cost analysis can add a variety of valuable new insights. Most important of all, at a time when all educational systems are running into extremely serious financial obstacles, cost analysis can be of major help in discovering ways to make better use of available resources, and in discovering what is and what is not economically feasible.

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Norway *13*

The use of educational cost models in planning the extension of compulsory education

prepared by Olav Magnussen

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Introduction

As a result of social pressures for more and better education, the Norwegian Parliament in 1959 decided in principle to extend the period of compulsory schooling from seven to nine years, throughout the country. The transition from seven to nine years' compulsory education demanded careful planning, in view of the fact that it would not only require additional resources, but would also affect all subsequent levels of the education system, since the higher-level secondary schools would all be based on the nine-year compulsory school. The reform required a detailed time-table and also certain parliamentary legislation, so that the first stage in the planning of this extension of compulsory schooling was to prepare detailed estimates of the costs of the proposed reform, and decide upon the organizational framework for the nine-year school. A Royal Committee was therefore set up in 1963 to prepare the necessary legislation for the reform, and to estimate its real cost, both in terms of financial resources and in terms of the additional teachers that would be required. The Committee was also asked to examine the experience of the municipalities which had already introduced nine-year schooling, on an experimental basis, and to review the school systems of other Scandinavian countries in order to provide a basis for the organization of the new school system, and its curriculum.

The Committee reported in 1965, and the report included proposals concerning the structure and administration of the new school system, its finance, and curriculum. It was proposed that the responsibility for nine-year compulsory education should remain in the hands of the municipalities, but that the extent of central government subsidy should be increased to cover all current and capital expenditure, rather than teachers' salaries and some other items of current expenditure, as previously. The nine-year compulsory schooling should be seen as schooling for *all* children, regardless of background or ability, and should, in principle, be divided into two stages, a primary stage, consisting of grades 1 to 6, and a lower secondary stage, consisting of grades 7 to 9. The common curriculum for all pupils should include religion, mathematics, social sciences, natural sciences, Norwegian, English, physical training, etc., and in the final three years part of the school time-table should be devoted to optional subjects.

The Committee also prepared estimates of the cost and the teacher requirements of the proposed extension of compulsory education, based on a single set of assumptions about such factors as the number of pupils, the average size of classes, the utilization of teachers, and the salary level of teachers. On the basis of these calculations the Committee judged it feasible to complete the transition from seven to nine-year-schooling by 1970/71. However, it was clear that the estimation of the costs of the extension depended to a large extent on certain crucial assumptions, for instance about the size of classes in primary and lower secondary schools. And the choice of assumptions involved important policy decisions.

The timing of the reform therefore depended critically on these policy decisions and there was considerable debate in Norwegian educational circles about such

matters of policy as the desired teaching standards in the new school system, particularly in relation to class size. Therefore the Ministry of education decided that before preparing the necessary legislation it was advisable to examine more closely the relationships between various factors in the educational system and to analyse the cost implications of alternative policy decisions. In order to do this the Ministry of education developed a series of educational cost models, designed to reveal the interdependence of various crucial factors, and to compare the consequences of alternative values of these variables on the total financial and teacher requirements of the extension of compulsory schooling.

Thus, there is a very important distinction between the activity of the Royal Committee, which was essentially an attempt to provide a simple monetary *forecast*, and the Ministry of education's use of cost models, which was an attempt to *analyse* relationships between variables, and consequences of policy choices. One part of the experience of the Norwegian Ministry of education has already been reviewed in an OECD study on the use of mathematical models to determine the demand for and supply of teachers. In that case study, it was stated that 'the main lesson we hope should be drawn from our study is that forecasting teacher requirements ... is primarily an exercise in forecasting political behaviour. In demonstrating this we also want to advocate less emphasis on this kind of forecasting, and more concern about the systematic analysis of means/ends relationships in the field of education.'[1]

This case study goes a stage further by showing that such a systematic analysis of relationships can be applied to other elements of cost and be used to guide policy-making. Cost models can contribute to policy-making by sharing the cost implications of alternative policies, by focusing attention on crucial policy variables, and by emphasizing that any estimate of the cost of introducing an educational reform involves choices between alternative allocations of resources. Such a cost model has been used, in Norway, to provide a range of alternative estimates of the cost of nine-year compulsory schooling, which can be compared with the original estimate of the Royal Committee. These alternatives have recently been to Parliament when legislation was introduced to prepare for the adoption of nine-year schooling throughout Norway.

The present case study is concerned with the development and application of this cost model to the particular problem of planning the extension of compulsory schooling. Alternative solutions of the model, based on different assumptions about crucial policy variables, will be discussed in turn, and will be compared with the cost estimates of the Royal Committee (for convenience called RC63). These alternative solutions have two main functions. First, they provide a range of estimates of future costs, and secondly they help to explain the behaviour of costs, by revealing which variables have the greatest influence on total costs. Both these aspects of the model can serve an extremely useful purpose in guiding policy-

1. K. Eide, 'A Case-Study in the Application of Teacher Demand and Supply Models in Norway', contributed to the OECD *Study on the Demand for and Supply of Teachers in Primary and Secondary Education* (Paris, 1969).

(i.e. group for teaching purposes). In some cases a school district may be so small that all pupils in the age-group 7 to 12 (grades 1 to 6) are taught together in one class (i.e. group). In a slightly larger school district, there may be sufficient pupils for two classes, grades 1 to 3 being taught together, and grades 4 to 6 in another class. Thus pupils in grades 1 to 6 may be taught in one, two, or up to six separate classes. If there are sufficient pupils for six separate classes, for grades 1 to 6, this is called one *stream*. In the larger school districts, schools may be big enough to have several streams, so that there may be several classes catering for each grade. In the rest of this paper, a distinction will always be made between primary schools large enough to have an entire stream, and those in which grades 1 to 6 are taught together in fewer than 6 classes.

Lower-level secondary schools must, according to Norwegian legislation, be large enough to have at least one stream, that is at least one class must cater for each individual grade. So that whereas pupils of different grades may be taught together in the same class in a primary school, by the time they reach the lower-secondary level, separate teaching is given to pupils in each grade.

For most of the school day pupils are organized together in a *full class*, that is, a group of about 20 pupils in primary schools, and about 25 pupils in secondary schools. However, for some teaching purposes a larger or a smaller group of pupils is considered desirable. Therefore, a full class may be divided into small groups, to form a *divided class*, for instance for work in science laboratories; or in other circumstances, two or more full classes may be combined into one group to make a *combined class*. The distinction between these various forms of grouping is crucial for any estimate of the number of teaching-hours required for each pupil, and the cost-model which is discussed below accordingly distinguishes between full, divided or combined classes. Official statistics of 'average class-size' in Norway refer only to the *full class*.

II. A cost model for Norwegian education

A. A description of the model

In order to compare the cost of alternative policies with regard to nine-year compulsory education, the Ministry of education used a mathematical model of *total current costs*.[1] This model consists of a statement of a set of relationships between a number of variables expressed in terms of equations. These variables

1. Total recurrent costs include in Norway expenditure on teachers' wages and salaries (including leave and pension payments), expenditure on housing and transport of students, expenditure on furniture and equipment, wages of non-teaching personnel, purchase of non-durable materials, and maintenance of buildings and durable equipment. No allowance is made for depreciation or amortization of capital expenditure.

can be classified into three groups: (a) *policy* variables, which are a matter of choice by educational policy-makers; (b) *exogenous* variables, which are determined by forces beyond the immediate control of the policy-makers; and (c) *endogenous* variables, which are determined by the relationships in the model itself. This method of classifying variables is important, because it distinguishes between those factors which are within the control of the policy-maker, and those which are beyond his control. Of course, whether a factor is truly independent or dependent upon other factors and upon political decisions, is partly a question of time, and partly of political power. The policy-maker may have no control over a variable in the short run (for instance the supply of trained teachers) but may be able to affect it in the long run. Similarly, a factor may be beyond the control of a local authority, but within the control of the central government, or vice versa. Thus any attempt to classify variables into exogenous or endogenous variables must be influenced by the purposes of the model. Since this model is intended to reveal the cost implications of alternative decisions by the policy-maker, the distinction between policy variables and exogeneous variables reflects the extent of his control over the variables. Thus policy variables are those that are determined directly *by* the educational policy-maker, for instance class size; exogenous variables are determined outside the educational system, for instance the total number of school pupils; and endogenous variables are determined by the model itself, when the values of policy variables and exogenous variables are already given. An example is total cost.

Altogether the Norwegian model includes 85 variables, of which:

28 are determined by the policy-maker (policy)
20 are determined outside the model (exogenous)
37 are determined by the model (endogenous).

The variables are measured in terms of units such as money, number of hours, or number of pupils, or in terms of ratios. The model itself consists of a set of equations, in the form of identities or functions which express the relations between these variables. When all these equations are solved, simultaneously, they give the *total current cost* of compulsory education, and the *total teacher requirements*. Thus, by choosing different values for the policy variables, or assuming different values for the exogenous variables, the policy-maker can use the model to show not only the cost consequences of the decisions and assumptions, but also the demand for teachers implied by each alternative. The model therefore provides a detailed picture of the possibilities for decision open to the policy-maker and the results of alternative decisions in terms of total current cost and teacher requirements.

The purpose of the model has determined the concept of cost employed in the model. Because its purpose is to show the cost implications of variations in policy variables, it was decided to limit the model to *current* costs, rather than total costs, on the assumption that the cost of capital is approximately constant for all combinations of the policy variables included in the model. Thus the model excludes the capital cost of buildings or large-scale equipment, and also excludes the annual cost of the servicing of this capital, for instance interest payments or

depreciation. Only maintenance expenditure is included as part of the current costs. If the aim of the analysis had been to calculate total current expenditure, as usually defined, this would have been a serious omission, since interest payments and depreciation are usually included. However, the aim of the analysis is to estimate the effects of alternative policy decisions and therefore only that part of current cost which is assumed to be sensitive to the policy variables was included in the cost model. It was assumed that the annual cost of capital services was not sensitive to changes in the policy variables, and would vary only significantly from one set of alternatives to another. Thus, for the purposes of comparing the cost implications of alternative policy decisions, the model concentrates simply on current costs, defined as: expenditure on wages, salaries and pensions, expenditure on transport and housing for pupils, expenditure on furniture and books, and other current expenditure.

B. The variables

The model distinguishes between:

(a) two *levels* of compulsory education, i.e. primary education (grades 1 to 6), indicated by x in the model, and lower secondary education, (grades 7 to 9) indicated by y;

(b) six *types*, or size, of primary school, i.e. those in which grades 1 to 6 are taught in 1, 2 ... 6 or more classes, indicated in the model by subscripts 1 ... 6.

Therefore many of the variables have 7 different values, one for lower secondary schools (y) and one for each of the six types of primary school $(x_1 \ldots x_6)$.

The 85 variables in the model are classified as follows:

Symbol[1]	*Policy variables*
K	(i) Average class size (i.e. pupils per full class) for each class-type in primary school and lower-level secondary (7 values, i.e. $K_1^x \ldots K_6^x$, K^y).
H^1	(ii) Average number of hours taught in full class per year and per class in primary school and lower-level secondary (7 values, i.e. $H_1{}^1 \ldots H_6{}^1$, H^{1y}).
H^2	(iii) Average number of hours taught in divided classes (net) (i.e. minus hours taught in combined classes) in primary school and lower-level secondary (7 values, i.e. $H_1{}^2 \ldots H_6{}^2$, H^{2y}).
t_p	(iv) Average number of hours (expressed in terms of reduced teaching obligations) spent on pedagogical supervision *per pupil* and per year in compulsory education (1 value).
t_a	(v) Average number of administrative hours *per pupil* per year in primary education and lower-level secondary (2 values, i.e. T_a^x, T_a^y).
a	(vi) Level of other current costs *per school* '*hour*' (1 value).

1. The notation employed here distinguishes between variables which express *total* expenditure, e.g. W and M, and expenditure *per hour* or *per pupil*, e.g. w and m.

m	(vii) Level of expenditure on books and furniture *per pupil* (1 value).
e_t	(viii) The percentage of pupils requiring transport (1 value).
e_h	(ix) The percentage of pupils requiring housing (1 value).

There are therefore 28 different values for the policy variables.

Symbol	*Exogenous variables*
E	(i) The total number of students (1 value) and the number of students in each class-type in grades 1 to 6 in primary school and lower-level secondary (7 values, i.e. E_1 ... E_6, E^y).
w	(ii) Average wage *per hour* for teachers in primary school and lower-level secondary (2 values, i.e. w^x, w^y).
P	(iii) Teaching personnel on leave as a percentage of personnel in service in primary school and lower-level secondary (2 values, i.e. P^x, P^y).
s_h	(iv) Housing costs *per pupil* (1 value).
s_t	(v) Transport costs *per pupil* (1 value).
p	(vi) Percentage of public expenditure on wages and salaries spent on pensions in primary school and lower-level secondary (2 values, i.e. p^x, p^y).
O	(vii) Teaching obligations per week in primary school and lower-level secondary (2 values, i.e. O^x, O^y).
B	(viii) Number of school weeks a year in primary school and lower-level secondary (2 values, i.e. B^x, B^y).

Altogether there are 20 exogenous variables.

Symbol	*Endogenous variables*
C	(i) Total current costs (1 value).
W	(ii) Total expenditure on wages and pensions in compulsory education (1 value).
S	(iii) Expenditure on housing and transport (1 value).
M	(iv) Expenditure on furniture and books (1 value).
A	(v) Other current expenditure (1 value).
W_L	(vi) Expenditure on wages and salaries for teachers in primary school and lower level secondary (2 values, i.e. $W_L{}^x$, $W_L{}^y$).
W_P	(vii) Expenditure on pensions for teachers in primary and lower-level secondary (2 values, i.e. $W_P{}^x$, $W_P{}^y$).
t	(viii) Total school 'hours' requirements *per pupil* for each class-type in primary school and lower-level secondary (7 values, i.e. $T_1{}^x$ ... $T_6{}^x$, T^y). (An 'hour' is a 45-minute teaching period.)
t_u	(ix) Teacher 'hours' *per pupil* per year spent on teaching in each class-type in primary school and lower-level secondary (7 values, i.e. $T_{u1}{}^x$ ... $T_{u6}{}^x$, $T_u{}^y$).
E_t	(x) Number of pupils requiring transport (1 value).
E_h	(xi) Number of students requiring housing (1 value).
T	(xii) Total school 'hours' requirements in the compulsory school (1 value):
L	(xiii) The demand for teachers in primary school and lower-level secondary (2 values, i.e. L^x, L^y).
l	(xiv) Teacher requirement per pupil per class-type in the primary school and lower level secondary (7 values, i.e. $l_1{}^x$ ... $l_6{}^x$, l^y).

S_h (xv) Expenditure on housing (1 value).
S_t (xvi) Expenditure on transport (1 value)
There are therefore 37 endogenous variables.

C. The functioning of the model

The model consists of 37 equations, expressed in terms of the 85 variables, which together determine the values of the 37 endogenous variables. The equations consist either of identities, for example C = W + S + M + A (total current cost = expenditure on wages, salaries and pensions, expenditure on transport and housing, expenditure on furniture and books, and other current expenditure); or of functions expressed in terms of exogenous or policy variables, for example,

$$T^y_u = \frac{H^{1y} + H^{2y}}{K^y}$$

(teaching-hours per pupil in lower-secondary school = hours taught in full class + hours taught in divided classes (net) divided by average class size in lower-secondary schools).

The full set of equations for the cost model is given in Appendix I. Figure 1 shows, in diagrammatic form, the functioning of the model. After certain values of the policy variables and the exogenous variables have been selected, to correspond with alternative policy decisions, the equations are solved to give the four components of current expenditure (W, S, M and A) and thus total current cost (C) and total teacher requirements (L). The model provides separate sub-totals for each of the sizes or types of primary school and lower secondary schools.

The model demonstrates the interdependence between variables, as shown in the examples below.

(i) Expenditure on wages and salaries (W_L)
This is dependent on three variables, the average wage per hour, (w), which is assumed to be fixed for purposes of the model, the proportion of teachers who are on paid leave (P), which is also assumed to be determined exogenously, and the total 'school-hours' required in each level of compulsory education. This last variable is itself determined by the model.

(ii) 'School-hours' requirement (T)
This variable is determined by the total 'school-hours' requirement per pupil at each level of compulsory education, and the total enrolment (E). The number of hours required per pupil is partly determined by policy decisions regarding the time to be devoted to administration and pedagogical supervision (t_a and t_r), and partly by the teaching-hours required by each pupil, which must be calculated from the model (t_u).

(iii) Teaching-hours per pupil (t_u)
This variable is dependent upon three policy decisions, the time to be spent by

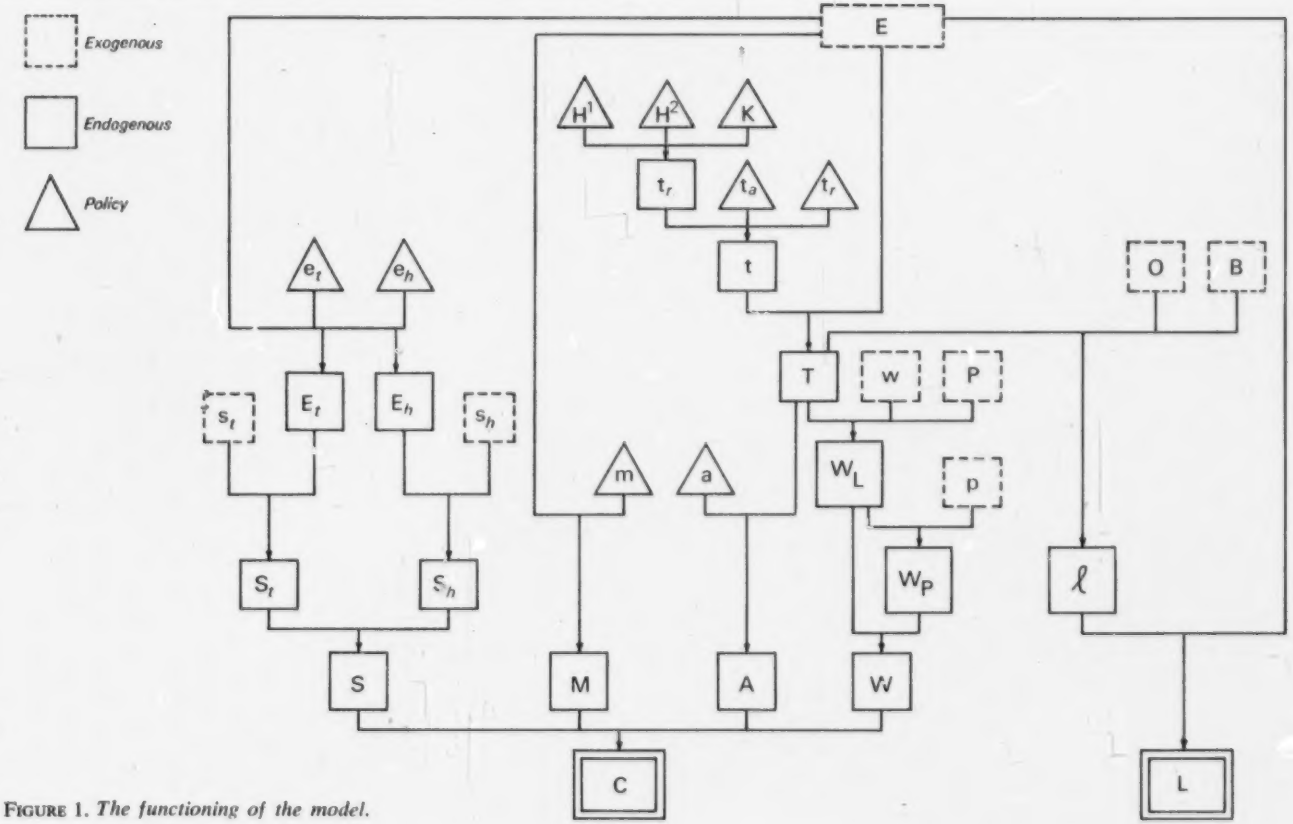


FIGURE 1. *The functioning of the model.*

each pupil in a full class (H^1), the additional hours spent in divided classes after subtracting the time spent in combined classes (H^2), and the average size of a full class (K). Since the teaching-hours devoted to each pupil will vary, according to whether a class in primary school includes one or more grades, this calculation must be carried out separately for each type of primary school, as well as for lower-secondary schools. Thus the total teaching-hours requirement for compulsory education is obtained by adding together seven sub-totals, ($t_{u1}{}^x$ ... $t_{u6}{}^x$ + $t_u{}^y$).

(iv) Expenditure on housing and transport (S)
This variable is calculated by estimating, separately, expenditure on housing (S_h) and transport (S_t), which are determined by policy decisions about the proportion of pupils to receive housing and transport (e_h and e_t), the total enrolment (E) and the cost per pupil of accommodation or transport (s_h, s_t) which is assumed to be fixed. By choosing different values for e_h and e_t, the policy-maker is able to simulate, through the model, the cost effects of alternative types of schools, small local ones (decentralization) or fewer larger ones at certain centres (centralization).

(v) Expenditure on furniture and books (M)
In the cost model this expenditure is assumed to be proportional to the total number of students in the compulsory school (E). A consequence of this assumption is that the estimated expenditure on equipment and books is independent of the size-distribution of schools, i.e. that there are no economies of scale in the use of equipment and books. There is, however, some scattered evidence to the contrary, which means that expenditure per student in Norway is lower in larger schools than in the smaller. Hence, the assumption is not very realistic if the size-distribution changes over time. This expenditure is, on the other hand, small in comparison with total expenditure, and any erroneous conclusions in this sub-sector will not affect the main results of the model.

(vi) Other current expenditure
This variable is assumed to be proportional to the total input of 'school-hours' in the compulsory school. The basis for this assumption is probably even weaker than for *(v)*, as there is considerable evidence of significant economies of scale. The statistical data necessary to undertake a rigorous analysis of economies of scale in this sector are, however, lacking. This cost item is also very heterogeneous, as it consists of expenditure on wages for personnel other than teachers, purchase of goods and services, and maintenance of buildings and durable equipment. From a theoretical point of view it would have been desirable to have a separate equation for each of these cost items, but lack of data has prevented the introduction of such a refinement. This difficulty and the fact that the model does not take into account the effects of economies of scale, reduces the usefulness of the equation for forecasting purposes. But as in the case of *(v)*, this has little effect on the main conclusions (C).

(vii) Teacher requirements (L)

The model not only gives the cost consequences of alternative values of the policy variables and exogenous variables, but also the demand for teachers implied by each alternative. This is done by the introduction of four new variables:

Teaching obligations per week in the primary school (O^x).
Teaching obligations per week in the lower-level secondary (O^y).
Number of school-weeks per year in primary school (B^x).
Number of school-weeks per year in lower-level secondary (B^y).

The demand for teachers implied by a certain combination of policy variables and exogenous variables is estimated by dividing the total 'school-hours' requirement by the product of the two factors O and E for the primary school and the lower-level secondary school separately. In this way it is possible to project the future demand for teachers as determined by the various combinations of policy and exogenous variables. Thus these results can be used to determine the capacity of the teacher-training colleges, which would ensure a balance between supply and demand for teachers.

In Norway such projections have led to the conclusion that, with the present level of educational technology, the school system will need so many more teachers in the future that it is imperative to make innovations in educational technology in order that machines and equipment can be substituted for teachers. How to substitute machines for teachers and find methods of teaching which require fewer teachers is, of course, a question of great importance in educational planning, but it is outside the scope of the present discussion.

D. Some limitations and strengths of the model

In the model there is no answer to this problem of substitution. The model cannot be used to answer a question such as 'How much must the input of machine-hours be increased to keep the over-all effectiveness constant when the input of teacher-hours is reduced by one?' To deal satisfactorily with this problem it would be necessary to have, in addition to the other equations in the model, a 'multi-product' production function and a preference function giving the relative priority attached to different educational 'products' as seen from the point of view of the educator and the politician. It would then be possible to find the optimal solution, i.e. the highest point on the preference function compatible with given costs. The author believes that no study has yet been able to incorporate either a 'production function' or a preference ordering of the different 'products' explicitly in such an analysis as is described in this case study.

There is no measure of over-all effectiveness in the model, and since the effectiveness of the different combinations of policy variables and exogenous variables presumably varies from combination to combination, it might be thought very difficult for the policy-maker to draw any conclusions from a study on the model. Educators should, on the other hand, be assumed to have some knowledge of the effect of certain changes in policy variables and exogenous variables on the

educational production function which can form a basis for decision-making when compared with information about the costs of each alternative. The policy-maker will then be able to make a choice between these alternatives on the basis of certain preferences or priorities. Thus, a certain intuitive knowledge of both the production function and the preference function must be assumed. In this case, therefore, a model which demonstrates the cost consequences of alternative educational policies can illuminate the problem of how to allocate scarce resources between alternative uses of these resources, and thus contribute to a more rational decision-making process.

Thus even if the method employed in the Norwegian cost model is very far from solving an optimization problem it is important because it can assist the policy-maker in choosing an alternative which is closer to the 'best' than if he were to rely on 'rules of thumb', where the different alternatives are not evaluated in terms of cost implications at all.

Another factor which has been omitted is the input of students' time. This is not very important in the context of planning compulsory education, since the opportunity cost of students' time in compulsory education is very small.

III. The application of the cost model as a means of comparing alternative cost estimates

The Ministry of education in Norway has used the cost model described in the previous section for two main purposes: (i) to obtain alternative estimates of the current cost of nine-year compulsory education, which were compared with the estimate of the Royal Committee (RC63); and (ii) to compare the cost implications of alternative policy decisions. These will be discussed in turn, but first it is necessary to give a very brief description of the method adopted by RC63 in estimating the cost of introducing nine-year compulsory schooling.

A. The RC63 cost estimates

The Committee judged that it would be feasible to complete the introduction of nine-year compulsory schooling throughout Norway by 1970/71. It therefore estimated the total current cost of compulsory education in 1970/71, distinguishing between the two levels, primary and lower-secondary.

The Committee's cost estimates were very much influenced by its estimate of *teachers' wages and salaries*, the largest single item of costs. Their estimate of teachers' wages depended on six main factors:

(i) The number of pupils in compulsory education.

(ii) Teacher-hours per pupil per week.
(iii) Extra hours spent on pedagogical supervision, administration, and extra teaching-hours due to illness, military service, etc.
(iv) Average class-size (i.e. number of pupils in a full class).
(v) Teaching obligations in hours per week.
(vi) Wages per hour.

The Committee assumed values for these factors, dealing separately with primary and lower-secondary education, in the following manner.

(i) Primary education

RC63 assumed an average wage rate per hour of Kr. 18.70, the wage per hour at 1 January 1965. When the law on compulsory schooling is discussed in Parliament, the average wage rate will be forecast on the basis of recent trends and expected future growth.

In 1965, the average class size was 19.5 pupils per full class. The average size of classes has increased by approximately 1 per cent per year during the last 15 years, due mainly to rationalization of the distribution of schools by sizes. Data obtained from local authorities on prospective trends suggested that the average class is expected to be 21.9 students per class when the introduction of compulsory schooling is completed, and this was the value assumed by RC63.

The number of hours taught in a full class (pupil-hours) is measured in terms of the number of hours every pupil is expected to be taught in the course of a week. In 1965, pupil-hours were on average 22.7 in grades 1 to 6; the legally permitted range is between 21 and 24.5 hours. RC63 assumed a figure of 23 for its calculations.

The number of hours taught in a full class is not, however, sufficient as a basis for calculating teacher-hours, because of the additional teaching-hours required by the division of classes into groups (minus the teaching-hours saved by the combination of classes). The Committee assumed that the number of extra teaching-hours would amount to 6 per cent of total teaching-hours. RC63 also estimated 'equivalent teaching-hours' for pedagogical supervision, and administration, etc., expressed in terms of a reduction in teaching obligations. The Committee assumed that this would be equivalent to 10 per cent of the total of hours taught in full classes together with net additional hours taught in divided classes.

The result of these two assumptions is a total requirement of 3.8 extra teaching-hours per pupil, per week, and this was the figure used by RC63 in its calculations of teacher demand.

Normal teaching obligations in 1965 amounted to 33 hours per week. However, many teachers work only 30 hours a week, and RC63 accordingly assumed a 32-hour week.

RC63 assumed that the number of pupils in primary schools in 1970/71 would be 380,372.

On the basis of these assumptions the total cost of teachers' wages, salaries and pensions, in primary schools in 1970/71 is estimated at Kr. 400 million.

(ii) Lower-level secondary education

The calculations of RC63 were based on the assumption of an average wage rate for teachers in lower-level secondary schools of Kr. 26.30 per hour.

In 1965 the average class size in lower secondary schools was 24.9 pupils. RC63 assumed that by the time compulsory schooling had been introduced throughout Norway the average number of pupils per full class would be 25.7. This assumption was made on the basis of the size-distribution of lower secondary schools planned by the municipalities.[1]

The Committee recommended that the number of teaching-hours in a full class should be permitted to vary between 32 and 35, and accordingly assumed 33.5 as the average number of teaching-hours in full classes.

The Committee's estimate of the number of net additional hours' teaching needed for teaching in divided classes was based on an estimate by the Council for Experiment in Education which assumed that the net number of hours in divided classes varied from 18 in a lower-level secondary school with one class in each grade, to 9 in a school with 6 or more classes in each grade. Thus, the average number of hours spent in divided classes is a function of the school-size and the average number of these hours will depend on the assumed size-distribution of the schools. The data on planned size-distribution given to RC63 by the municipalities implies an average number of hours (net) in divided classes of 11.2 per week. The Committee estimated the number of additional hours needed for pedagogical supervision, administration, etc., on the same basis as for primary schools, namely that these would amount to 10 per cent of the total hours spent in full class and additional (net) hours in divided classes.

The Committee's estimate of the total enrolment in lower secondary schools was 191,300.

RC63 assumed that the existing regulations concerning teaching obligations would remain in force, giving 25 hours per week as the normal teaching obligation.

The effect of all these assumptions on the total of teachers' wages, salaries and pensions in lower-secondary schools in 1970/71 is estimated at Kr. 436 million.

(iii) Joint costs

The Committee's estimates of *expenditure on transport and housing* for school pupils did not differentiate between the two levels of compulsory education. The estimate for both levels combined, for 1970/71, was Kr. 84.5 million.

Finally RC63 estimated other current expenditure, which includes expenditure on wages and salaries of non-teaching staff (e.g. cleaners), expenditure on other goods and services and maintenance. The method adopted by RC63 was simply to assume that other current expenditure was proportional to the wages of teachers and would amount to 35 per cent of total current expenditure (minus pensions and transport and housing costs) in 1970/71 Pensions were assumed to amount to 10.7 per cent of the total wages and salaries bill, as estimated above. These assumptions gave an estimate for other current expenditure of Kr. 402 million.

1. The assumed size distribution is discussed in Part III.B, below.

TABLE 1. RC63 estimates of total current cost of compulsory schooling in 1970/71

	Norwegian Kr. millions
(a) Wages, salaries, pensions, of teachers in primary schools (grades 1 to 6)	400
(b) Wages, salaries, pensions, of teachers in lower-secondary schools (grades 7 to 9)	436
Total wages	836
(c) Expenditure on transport and housing	84.5
(d) Other current expenditure	402
Total	1 322.5

TABLE 2. Assumptions of RC63

	Grades 1-6	Grades 7-9
(a) Wage rate per hour (N.Kr.)	18.7	26.3
(b) Average class size (pupils)	21.9	25.7
(c) Teaching-hours in a full class per pupil per week	23.0	33.5
(d) Additional (net) teaching-hours per pupil per week	3.8	15.7
(e) Teaching obligation (hours per week)	32.0	25.0
(f) Enrolment in 1970/71	380 322	191 300
(g) 'Other current expenditure' as % of total expenditure (pensions and housing and transport costs)	35	

Thus, the final estimate by RC63 for total current expenditure on compulsory schooling in 1970/71 was Kr. 1,322.5 million. The breakdown of this expenditure, and the combination of assumptions on which it was based, are shown in Tables 1 and 2.

B. Alternative cost estimates

This section will examine the alternative values of the variables which were used by the Ministry of education and show how they affect current costs.

Although RC63 assumed as a basis for its calculations that the introduction of nine-year schooling would be complete by 1970/71, it now seems likely that completion will not be before 1975/76. Therefore cost estimates were made for 1975/76, 1980/81 and 1985/86 as well as 1970/71.

1. *Implications of alternative assumptions on teachers' salary costs*

(a) Number of pupils

In addition to the projections of RC63, the Ministry of education used estimates based on population forecasts produced by the Central Bureau of Statistics and an assumed enrolment ratio of 99.6 per cent for the whole 7 to 15 age-group. The alternatives obtained for the total enrolment by level in the compulsory system are shown in Table 3.

TABLE 3. Enrolment assumptions

		Grades 1-6		Grades 7-9	
Hypothesis	Year	Enrolment	% difference from RC63	Enrolment	% difference from RC63
a_0	1970/71	380 372	0	191 300	0
a_1	1970/71	359 700	−5.4	150 000	−21.6
a_2	1975/76	370 600	−2.6	178 300	− 6.8
a_3	1980/81	413 300	+8.7	186 200	− 2.7

These figures show that after the introduction of the nine-year compulsory system, there will be a few 'quiet' years before pupil numbers are expanded by a new birth wave.

Table 3 shows also that the 1963 Committee over-estimated the number of pupils likely to be enrolled in 1970.[1] The cost implications of such over-estimations are Kr. 21.5 million for grades 1 to 6 and Kr. 27.5 million for grades 7 to 9. Thus, the use of more accurate enrolment forecasts implies a cost reduction of about Kr. 50 million. Similarly, the use of the revised enrolment projections for 1970/71 would imply a reduction in the demand for teachers for compulsory education of 1,800.

(b) Number of teaching-hours in full class per week

RC63 estimated this number to be 23, or 138 teacher-hours per stream for grades 1 to 6 in 1970/71. An investigation undertaken by the Planning Department produced an average of 136 hours per stream per week. This factor has increased over the last five years and is expected to continue growing in the future. Thus, the Ministry did not make alternative assumptions for this variable for grades 1 to 6.

For grades 7 to 9 a set of three values was used in the calculations: these were b_0 33.5 (the RC63 hypothesis), b_1 36.0 (the actual 1965 value) and b_3 30.0 (which would be brought about by the adoption of a five-year school week with 6 hours per day). If the actual number of teaching-hours spent at school remains the same

1. a_1 is based on a rate of attendance of 81.5 per cent. If the rate of attendance is to reach 100 per cent in 1970/71, enrolment in grades 7–9 would be 184,000 pupils, instead of 150,000.

in 1970/71 as it was in 1965 (36 hours), salary costs will increase by Kr. 32.5 million, and the demand for teachers will be 1,100 more than that forecast by RC63. On the other hand, if the third alternative is assumed, salary costs will be reduced by Kr. 46 million and the demand for teachers by 1,540 compared with RC63.

(c) Extra hours

The circumstances under which extra hours are worked fall into three basic categories: (i) the division or combination of classes; (ii) the need for pedagogical supervision or administration; (iii) the replacement of teachers on paid leave.

The increase in the number of extra hours taught in divided classes is a major cause of the expansion of teacher demand in recent years. This factor also helps to explain why the unit cost in grades 7 to 9 is much higher than in grades 1 to 6.

The number of extra teaching-hours is in many ways an important measure of the teaching standard in the lower-level secondary. There is every reason to expect that the number of these hours will increase considerably in the future. When examining various alternative hypotheses about the development of compulsory education, it is therefore reasonable to assume an increased number of extra hours, due mainly to pressure for over-all improvement in education.[1]

In the case of primary education, a proposal by the Norwegian Teachers' Association suggests that extra hours in divided classes should amount to 20 per cent of the number of teaching-hours in a full class. As it is the largest teacher organization which made this proposal, it was included among the alternatives considered by the Ministry of education. Another alternative results from an investigation made by the Planning Department, which showed that the 6 per cent assumed by RC63 should be increased to 7 per cent.

RC63 assumed that the extra hours for pedagogical supervision and administration accounted for 10 per cent of the teaching-hours in full and divided classes, but the Planning Department assumed that this percentage was about 19.

Thus, the Ministry's study used the following alternatives for grades 1 to 6:

		Percentage difference from RC63
Hypothesis C_0	5.1 hours per class	0
C_1	7.6 hours per class	+ 8
C_2	10.9 hours per class	+ 20

RC63's under-estimation of the number of extra hours required in primary schools means therefore that total current costs are Kr. 32 million more and that

1. 'One radical proposal is that all classes in grade 1 should be split into two. This proposal alone would require an increase in the stock of teachers in primary education by 11 per cent.' See OECD, op. cit.

1,180 more teachers are needed. If the proposal by the Norwegian Teachers' Association is accepted (C_3), costs would increase by Kr. 40 million and the demand for teachers by 1,620.

In grades 7 to 9, the number of hours (net) spent in divided classes is a function of school size, and therefore the average number of hours will depend on the assumed size distribution. The main assumption of RC63, based on the planned size-distribution of schools provided by the municipalities, was 11.2 hours per week. But the Ministry of education felt it useful to consider alternatives based on a greater degree of either centralization or decentralization of schools. Greater centralization combined with the other assumptions of RC63 would involve 10 additional hours per class, whereas the decentralization alternative would mean 12.5 extra hours.

In another paper the Council for Experiment in Education argued that it is perhaps sufficient to have eight hours in divided classes (net) for schools with two or more classes in each grade. This proposal will also be included in the set of alternatives.

RC63 assumed that hours spent on pedagogical supervision, administration, etc., total about 10 per cent of the sum of teacher-hours in full and divided classes (net). An investigation undertaken by the Planning Department on the basis of information obtained from the municipalities showed that in fact additional hours spent on pedagogical supervision etc., amounted to 16.4 per cent.

The combined result of these alternative assumptions is as follows:

		% difference from RC63
Hypothesis C_0	10, 11.2 or 12.5 hours in divided classes, per class	0
C_1	10, 11.2 or 12.5 hours in divided classes, per class Other extra hours + 16.4 per cent	+ 5.7
C_2	8 hours in divided classes, per class Other extra hours + 16.4 per cent	− 4.0, − 9.5[1]

If the alternative C_1 is adopted, instead of RC63's assumptions C_0, the cost estimates would be increased by Kr. 25 million and the demand for teachers by 830. The alternative C_2 would result in an estimate of costs Kr. 42 million to Kr. 66 million lower than C_1 and an estimate of teacher demand lower by 1,420 to 2,220, according to the size-distribution of schools.

(d) Class size

The previous section showed that the number of additional hours' teaching considered necessary in lower-secondary schools depended upon the size-distribution of schools. This is because the average size of a full class is directly related to the number of classes catering for each grade. One important question therefore is

1. Depends upon the size-distribution of lower-level secondary schools.

what would be the implication for average class size—and hence for teaching costs—if the Norwegian government adopted a change of policy on the distribution of schools throughout the country? RC63 assumed that in 1970/71 there would be 631 schools in grades 7 to 9 with the distribution shown in Table 4.

TABLE 4. RC63 assumption of size distribution of lower-secondary schools in 1970/71

Type of school	Number of schools
1 class in each grade	16
2 classes in each grade	144
3 classes in each grade	157
4 classes in each grade	122
5 classes in each grade	67
6 classes in each grade	90
7 classes in each grade	16
8 classes in each grade	14
9 classes in each grade	0
10 classes in each grade	3
11 classes in each grade	0
12 classes in each grade	1
13 classes in each grade	0
14 classes in each grade	1
Total	631

This assumption was based on the existing plans of the municipalities in 1965, i.e., it implies an average class size of 25.7 pupils in lower secondary schools in 1970/71. If, on the other hand, the government adopted a policy of decentralization, and the same number of pupils were distributed in 860 schools, the distribution would be as shown in Table 5.

TABLE 5. Size distribution of lower secondary schools (decentralization policy)

Type of school	Number of schools[1]
1 class in each grade	100
2 classes in each grade	300
3 classes in each grade	200
4 classes in each grade	122
5 classes in each grade	67
6 classes in each grade	71
Total	860

1. This size distribution is based not on actual distribution but on a hypothesis for the future.

In this case the average number of students in each class would be 24.4.

When using the cost model the Planning Department therefore used two alternative hypotheses on class size; one is intended to illustrate the effect of a high degree of centralization, the other that of a high degree of decentralization.

TABLE 6. Primary and lower-secondary schools; class sizes

Hypothesis	Grades 1-6	% difference from RC63	Grades 7-9	% difference from RC63
d_0	21.9 students per class	0	25.7 students per class	0
d_1	19.5 students per class	+11.0	24.4 students per class	+5.3
d_2	23.0 students per class	− 5.0	26.5 students per class	−3.0

The direct effect of changing the average size of a full class is on the demand for teachers, but obviously costs will also be influenced. The wages of teachers will be affected and also the cost of transport and housing of pupils. No precise calculation has been made of the impact of alternative distributions of schools on transport and housing costs, since the model does not relate expenditure on housing and transport to the geographical distribution of schools, but a rough estimate can be made.

A decentralization policy would increase expenditure on teachers' wages by Kr. 40 million in grades 1 to 6 and by Kr. 44 million in grades 7 to 9. Such a high degree of decentralization would have a slight effect in reducing expenditure on housing and transport. On the other hand, a centralization policy would reduce wage costs by Kr. 20 million in grades 1 to 6 and Kr. 25 million in grades 7 to 9. The high degree of centralization would also, of course, increase the cost of housing and transport, and the question is by how much. However, as mentioned above, the model does not help in answering this question. This is one of the limitations of the cost model since it does not provide a means of comparing the costs of boarding versus day schools, or the cost of housing and transport in a system with large schools compared with high tuition costs in small schools, and lower transport costs.

(e) Teaching obligations

RC63 assumed a slight decrease in the number of teaching obligations per week—32 hours in grades 1 to 6 and 25 hours in grades 7 to 9. The Ministry also examined the cost implications of an even larger reduction in teaching obligations in primary schools, namely, a reduction to 30 hours per week. This has, in fact, been proposed by the Teachers' Association. Assuming this reduction of teaching obligations, combined with a constant wage rate, it would have the effect of increasing the demand for teachers by 1,330 and expenditure on wages by Kr. 36.4 million.

(f) The rate of hourly wages

Any change in the assumed wage rate for teachers would obviously have a substantial effect on estimated expenditure on teacher salaries. However, as has already been emphasized, the purpose of this exercise was to demonstrate, to Parliament, the effect of alternative policies for the Ministry of education. Forecasts of changes

in wage rates are the responsibility of the Ministry of finance in Norway. Therefore the Planning Department in the Ministry of education did not consider any alternatives to the wage rate used in the RC63 cost estimates, which was the wage rate prevailing in 1965. If the intention of the exercise had been to provide accurate forecasts of expenditure this would have been a serious error, for it might be assumed that as a minimum, teacher wage rates would rise with *per capita* income.

The growth of GNP in Norway over the last few years has been approximately 5 per cent annually. If a somewhat slower growth in the future is assumed, then the growth of real income per inhabitant might be at the rate of 4 per cent per year. This would lead to an increase in the real wage of 22 per cent over five years, 50 per cent over 10 years, 80 per cent over 15 years, and 120 per cent over 20 years. Thus it is obvious that any cost forecasts would have to take this into account. But such a rate of growth would have an equivalent effect on total expenditure on wages, regardless of whether the policy assumptions of RC63 were adopted, or alternative policy assumptions. Therefore, for the purposes of comparing alternative policy decisions, it is quite reasonable to assume a constant wage rate.

However, the Ministry did analyse the cost implication of one alternative assumption about the wage rate in primary schools. This is because RC63 used the wage rate for teachers only, whereas if allowance is made for higher wage rates for principals and inspectors, the average wage rate in primary schools would be 2.5 per cent higher than the RC63 assumption. Adopting a wage rate of Kr. 19.17 an hour instead of Kr. 18.70 would increase expenditure on wages by Kr. 10 million.

2. *Other current expenditure*

The 1963 Committee made a proposal that all current costs should be subsidized by the central government, although, as has already been pointed out, at present only teachers' wages and a small part of other current costs are thus subsidized. If such a proposal were accepted by Parliament the hypothesis of RC63 that other current expenditure will amount to 35 per cent of total current expenditure in 1970/71 will have to be reconsidered.

For example, considerable differences exist among the municipalities in the allocation of 'other current expenditure', particularly expenditure for books and furniture. If the government accepts responsibility for 60 to 70 per cent of these expenditures, there is good reason to believe that most municipalities will increase their expenditures in this category much faster than they would have done in a situation with no subsidies.

In 1964 total current costs were distributed as follows:

Wages and salaries for teachers, principals and inspectors	67 %
Other current expenditure (expenditure on housing and conveyance not included)	33 %

According to the municipal accounts, other current costs consist of:

Expenditure on wages and salaries for other personnel (e.g. cleaners)	13 %
Purchase of goods and services	16 %
Maintenance	3 %
Subsidies to the private sector (e.g. scholarships)	1 %

No very accurate data is available on trends in such expenditure, but some rough guesses can be made of likely trends in the future. For example, the very high construction activity in the school sector recently will increase area per pupil considerably. More cleaning staff will therefore be required in the future. Thus, it is realistic to assume that expenditure on salaries of non-teaching staff will increase faster than total current costs. This development will be reinforced by the introduction of lower-level secondary schools, since on this level area per pupil is larger than in the primary school.

Purchase of goods and services includes expenditure on books and equipment. There is reason to believe that relatively more will be spent on this kind of educational input in the future. The introduction of the lower-level secondary will no doubt strengthen this trend.

There has been a great deal of investment in new school buildings in Norway, which means that their maintenance costs will be low in the future. However, the older school buildings are now needing more repair than in previous years and, as there are more of them than new buildings, the over-all effect will be an increase in the relative proportion of maintenance in total current costs in the future.

Subsidies to the private sector consist mainly of scholarships and grants to students given by the municipalities. This item too is likely to increase over time in proportion to total current costs.

This suggests that in the future it is realistic to count on a higher rate of increase in other current costs than in teachers' wages. RC63, however, estimated that other current costs would be proportional to wage costs and would amount to 35 per cent of total current costs when nine-year compulsory schooling is introduced. In the short run this estimate may be realistic, but over a period of 10–15 years it will certainly be too low.

If, however, the assumption of proportionality between teachers' wages and other current expenditure is accepted, and applied automatically to all the alternatives so far considered, it is likely to lead to an over-estimation of the other current costs in the case of 'expensive' alternatives and an under-estimation in the case of 'cheap' alternatives. Total expenditure on teachers' wages and salaries for the nine-year compulsory school in 1970/71 would be, on the assumption of RC63, Kr. 835 million.

When allowance is made for the costs of pensions (assumed to account for 10.7 per cent of this total), the figure is Kr. 746 million which implies 'other current expenditure' of Kr. 402 million. The Ministry of education calculated other current expenditure on the assumption of a constant proportion between these expenditures and teachers' wages, but at the same time considering the alternative assumptions about expenditure on teachers' wages, as discussed above. This calculation

TABLE 7. Teachers' wages and other current costs according to various alternatives (in Norwegian Kr. millions)

Assumptions		Teachers' wages	Other current costs
RC63	1970/71	746	402
Alternative 1	1970/71	697	375.5
	1975/76	768	413.5
Alternative 2	1970/71	900	484.5
	1975/76	990	533
Alternative 3	1970/71	593.5	319.5
	1975/76	649	349.5
Alternative 4	1970/71	691.5	372.5
	1975/76	759	408.5

revealed a variation of Kr. 350 million to Kr. 530 million, as shown in Table 7. The Ministry considered that the most realistic estimate of other current expenditure probably lay between Kr. 400 million and Kr. 450 million.

C. The impact of alternative assumptions on total current costs

RC63 estimated that the complete introduction of nine-year compulsory education would involve a total current expenditure of Kr. 1,322 million. This can be compared with an estimate made in the National Plan 1966-69 of the total current costs in 1965 of seven-year compulsory schooling, together with continuation schools and lower-level secondary schools (not compulsory in 1965). This estimate, which was only approximate, was Kr. 1,200 million. Thus, if the RC63 estimate is accepted, this would mean that nine-year compulsory education, when completely introduced, would cost approximately 10 per cent more than the general education given to the same age-group in 1964. However, the alternative policy assumptions discussed in the previous sections would result in different estimates of total cost.

This section will examine the impact, as shown by the cost-model, of alternative 'sets' of assumptions on total costs. There are, of course, many possible combinations of the various factors and when considering how many to take into account the only problem is one of computation. Therefore, it is valuable for planning purposes to select a small number of combinations of values and group them together into 'sets' which have no extra cost, 'sets' with 5 per cent extra cost, 'sets' with 10 per cent extra cost, and so on. Thus policy-makers can see which alternative decisions would have the same cost and which were the more or less costly.

The consequences of simultaneous changes in key factors are not obtained by a simple addition of partial consequences. If pupil numbers expand, for example, changes in the teaching-hours requirement will have a higher cost implication than in a situation of constant enrolment. The larger the total number of hours taught,

the higher the cost of teaching obligations. On the other hand, the larger the average size of the class, the less important are changes in wage rates. The cumulative impact of various changes reflects the structure of the model itself, and the relationships between factors, as shown in the equations of the model.

Thus the assumptions of RC63 are compared with another combination of variables which would result in approximately the same total cost, and with the two combinations of variables which offer the 'most expensive' and the 'cheapest' alternative. The combination which provides an estimate of cost roughly equal to the RC63 estimate is then called 'realistic' (in the sense that it would not involve any change in the level of expenditure proposed by the Committee), but it does represent an alternative set of policy decisions. Finally, the impact of certain 'corrections' to the RC63 assumptions is evaluated. This set of assumptions is called 'RC63 corrected', because it does not, strictly, represent an alternative to RC63 but simply uses more accurate data.

Before considering the cost consequences of these alternative 'sets' of assumptions, it might be useful to recapitulate on the full range of possible values for each variable discussed in the previous section. See Table 8.

TABLE 8. Possible values of cost variables

	1970/71 (RC63)	1970/71	1975/76
Grades 1 to 6			
Number of students	380 372	359 700	370 600
Teacher-hours per week, per class	23	—	—
Extra hours per week (net)	3.8	6.3	9.5
Average class size	21.9	23.0	19.5
Teaching obligation in hours per week	32	33	30
Wage level (Kr. per hour)	2.62	2.68	—
Grades 7 to 9			
Number of students	191 200	150 000	178 300
Teacher-hours per week, per class	33 5	36	30
Extra hours per week (net)	10, 11.2 or 12.5 + 10%	10, 11.2 or 12.5 + 16.4%	8 + 16.4%
Average class-size	25.7	26.5	24.4
Teaching obligations in hours per week	25	—	—
Wage level (Kr. per hour)	3.68	—	—

This range of possibilities involves a very large number of possible combinations of values, and 25 different possibilities are shown in Appendix II. In this case study only the five possible combinations of values described above are considered. They are RC63, RC63 (corrected), 'realistic alternative', 'cheapest alternative' and 'most expensive alternative'. These are shown, in summary form, in Table 9. Table 10 shows the estimate of total current cost, and total teacher requirements for nine-year compulsory education, for these combinations of values.

TABLE 9. Assumed values for policy and exogenous variables, in completed nine-year compulsory schooling programme

Variables		RC63	RC corrected	'Realistic' alternative	'Cheapest' alternative	'Most expensive' alternative
Primary (grades 1–6)						
No. of pupils and assumed	1970/71	380 372	359 700	359 700	359 700	359 700
date of completion	1975/76	—	—	370 600	370 600	370 600
Teaching-hours in full class per week		23	23	23	23	23
Additional hours (net)		3.8	6.3	6.3	6.3	9.5
Average class size		21.9	21.9	21.9	23.0	19.5
Teaching obligation (hours per week)		32	32	30	33	30
Wage-level (Kr. per hour)		18.70	19.17	19.17	19.17	19.17
Lower-secondary (grades 7–9)						
No. of pupils and assumed	1970/71	191 200	150 000	150 000	150 000	150 000
date of completion	1975/76	—	—	178 300	178 300	178 300
Teaching-hours in full class		33.5	33.5	33.5	30	36
Additional hours (net)		11.2 + 10 %	10, 11.2, or 12.5[1] + 16.4 %	8 + 16.4 %	8 + 16.4 %	12.5 + 16.4 %
Average class size		25.7	25.7	25.7	26.5	24.4
Teaching obligation (hours per week)		25	25	25	25	25
Wage-level (Kr. per hour)		26.30	26.30	26.30	26.30	26.30

1. Dependent upon distribution of schools.

TABLE 10. Estimate of total current cost (Kr. millions) and total teacher requirements for nine-year compulsory education

	Estimated total current cost		Total teacher requirements	
	1970/71	1975/76	1970/71	1975/76
RC63	1 322	—	29 385	—
RC63 (corrected)	1 240	1 360	26 750	29 460
'Most expensive' alternative	1 560	1 710	34 590	37 980
'Cheapest' alternative	1 100	1 190	22 830	24 930
'Realistic' alternative	1 230	1 340	26 660	29 160

IV. Some policy implications of the use of the Norwegian cost model

If all the possible values of policy and exogenous variables, considered above, are regarded as falling within the total range of 'reasonable' assumptions, the difference in cost between the cheapest and the most expensive alternative is as high as Kr. 460 million in 1970/71, and Kr. 520 million in 1975/76. That is, there is a difference of almost 50 per cent between the cheapest and the most expensive alternative. Thus, it clearly shows the important economic consequences of any major decision concerning the future structure of schooling in Norway. This is equally true of the impact of such decisions on the demand for teachers. The maximum difference between the alternatives is 11,760 teachers for 1970/71 and 13,050 teachers for 1975/76. In both cases this implies a difference of more than 50 per cent.

Thus, decisions concerning the structure of the nine-year compulsory school will have a decisive effect on future capacity requirements for the teacher colleges and on the proportion of highly qualified manpower which will be employed in the nine-year compulsory school in the future.

The assumption described as 'realistic' is perhaps the most reasonable of the three, in that it seems to fit in with the most likely evolution of compulsory education without involving a noticeable rise in costs. It has taken into consideration the pressure from the Teachers' Association for reducing the weekly teaching obligation and the proposal by the Council for Experimen in Education for no more than eight extra teaching-hours in grades 7 to 9. Obviously the Norwegian government has to find a compromise between the various requests for improvement and change; for example, if it decreases the normal weekly teaching obligation, it cannot increase the number of extra hours taught in divided classes without a massive increase in teacher supply. In a sense, therefore, there is a range of 'realistic alternatives' which all have about the same cost, but which represent different solutions to this problem of compromise.

The 'most expensive' alternative is clearly not the most expensive alternative of all, but the most expensive of those considered feasible by the Ministry of education. Similarly, the cheapest alternative is not the cheapest of all possible alternatives, but was considered the cheapest in the light of certain basic facts and constraints of the Norwegian educational system.

The model not only shows the combined impact of a combination of assumptions, but also shows the partial effects on cost of different 'strategic' decisions. For instance, variations in total current cost due to different values of teacher-hours per week amount to Kr. 100 million. If some of the most radical suggestions were to be adopted this might affect costs by more than Kr. 150 million.

The largest difference in cost shown by the model was due to variations in policy over the size-distribution of schools, including its indirect effects on requirements for extra teaching-hours. This had a possible impact on total costs of up to Kr. 150 million.

Thus, the Norwegian cost model demonstrates the connexion between particular policy changes and costs and teacher demand, information which can be very useful in policy-making.

One example of such a use of the model in Norway can be given. In general, the Parliamentary Committee which examined the proposals put forward by the Ministry of education on nine-year compulsory schooling was more concerned with questions of a direct political nature than with a comparison of the resource requirements of different proposals, but one of its conclusions used in direct form the information provided by this cost analysis and is a good example of the usefulness of the model. The Norwegian Teachers' Association proposed to the Committee that the maximum class size in compulsory school should be reduced from 30 to 25, arguing that this would be of pedagogical value. The Parliamentary Committee, on the other hand, while agreeing that such a measure would have pedagogical value, argued that it would slow down the introduction of compulsory schooling, because of its effects on total costs and teacher demand. The Committee referred to the Ministry's estimates of the effects of a change in *average* class size, and pointed out that a reduction in *maximum* class size from 30 to 25 would influence average class size. The Committee did not, therefore, accept the proposal, but instead suggested alternative measures to raise the quality of teaching, to counteract the negative effects of a large maximum class size.

The main factor mentioned by the Committee was an increase in the number of hours taught in divided classes. It was argued that this would also be of great pedagogical value but would have less effect on total costs or teacher demand than the alternative proposal.

A cost model, similar to the one described in this case-study, has been used by the Planning Department of the Ministry of education as one of its basic tools for planning and forecasting. A simplified version has been used in the preparation of the annual budget and of a long-term projection up to 1990 used by the Ministry of finance. The Planning Department has also developed a cost model for universities, which will shortly be used in the development of a programme-budgeting model.

V. An evaluation by IIEP of the Norwegian experience

This case study has suggested some of the uses of the Norwegian cost model of compulsory education. Its particular value is that it can be used as a 'simulation' model to allow the policy-maker to analyse cost behaviour and compare the cost-implications of alternative decisions, and to judge the impact of particular policy variables on both total current costs and teacher demand.

By expressing, in simple mathematical terms, the relations between various factors, the model allows the policy-maker to have a more detailed understanding of the inter-relationships between policy decisions and factors within and outside his immediate control. The system of equations, presented in Appendix I, summarizes certain basic features of an educational system, and these are applicable to other countries besides Norway.

The use of the model demonstrates and emphasizes the necessity for reliable school statistics and population statistics. The mistaken assumptions of RC63 about future enrolments caused an over-estimate of almost Kr. 50 million for 1970/71. The model can, in fact, help by pointing out gaps in statistical knowledge, and this information can be used to improve educational statistics. For example, lack of information about the breakdown and distribution of 'other current expenditure' in Norway meant that the model had to be slightly adapted and simplified. Similarly, the model makes simplified assumptions about the effect of economies of scale, because no adequate information on this issue existed in Norway. Thus the impact of this experience on the development of statistical services in Norway may prove an important by-product of the analysis itself.

The use of such models can help shatter popular myths about the most important factors determining current costs. For example, it used to be believed in Norway, and still is believed in many countries, that growth in the total number of pupils was the most decisive factor in determining costs. The cost model for Norway has demonstrated that this is not so, by revealing the greater impact of such factors as the size-distribution of schools, through its effect on average class size, and the requirement for additional teacher-hours for teaching in divided classes. Thus, by using such models, the policy-maker is made aware of the importance of factors which are more within his control than the size of enrolments.

Another important feature of the Norwegian cost model is that it analyses at the same time the effect of various factors on money costs and on demand for real resources (i.e. teachers). Since in most countries, developing as well as developed, teachers represent the scarcest of all scarce resources, this dual function of such cost models can be very important.

However, capital costs were not considered in the Norwegian model—it was assumed that there was very little difference in the capital cost per place for schools, or classes, of different sizes and that, as the school system would automatically expand with the rate of growth of population, the annual capital cost could be considered constant for all different assumptions. This point may be valid for

the assumptions of the Ministry of education (universal nine-year schooling by 1975/76) but not for the assumptions of RC63 (universal nine-year schooling by 1970/71). Obviously the annual capital expenditure would be much higher on the basis of RC63 assumptions.

But in the introduction of a compulsory education programme in developing countries it is necessary, as well as working out the recurrent costs and teacher obligations for alternative completion dates, to know the capital costs of the various alternatives; the financial feasibility, of course, depends on the combined capital and recurrent costs per year.

In addition, in developing countries it is not only the phasing of a compulsory educational programme that will affect the capital cost. In another case study in this series[1] it was shown that the capital cost per place (not the cost per square metre) was inversely related to the size of the school; the smaller the school, the greater the space that would be needed per pupil. Thus, in a day-school system the greater the decentralization, the higher the capital costs will be for a given programme.

On the other hand, many countries provide boarding facilities for children living long distances from their schools. In the Norwegian model the percentage of children requiring transport and boarding facilities was regarded as a policy variable, whilst in fact it should be dependent on the degree of centralization or decentralization and the relative costs (including amortization of capital) of transportation or boarding facilities. Obviously, centralization entails higher boarding and transportation costs. Thus, in a country where significant proportions of children are either transported to school or boarded, it would be advisable to develop a model treating these factors as endogenous and not policy variables. The Norwegian model as at present designed cannot indicate the optimum degree of decentralization, nor can it help in deciding what proportion of children living in remote areas should board at school and what proportion should be transported each day.

Another problem of major importance to planners in developing countries which is not fully considered in the Norwegian model is the question of changes in the qualification and age-structure of the teaching force. Several case studies in this series have emphasized this problem—one studies in detail the changes in average teachers' earnings and shows that, even assuming constant salary scales, these by no means remain constant: the faster the rate of growth of the stock of teachers with a particular qualification, the lower the average salary.[2] The Norwegian model, however, assumes constant hourly earnings of teachers of a particular grade no matter what the rate of growth of the stock. Thus, though it might be true that the average hourly earnings of teachers in Norway is an exogenous variable, in many developing countries where teachers' salaries increase with length of service this should be treated as an endogenous variable.

1. *United Kingdom: the use of cost analysis to improve the efficiency of school building*, in Volume III of this series.
2. *Tanzania: factors influencing change in teachers' basic salaries*, in Volume I of this series.

Models such as the Norwegian one are simplifications of reality. They are designed to answer specific questions about certain predetermined alternatives and they do not pretend to have universal applicability. The effects of different completion dates for the nine-year compulsory schooling, the proportion of day and boarding schools, and the qualification and age-structure of the teaching force have probably only marginal effect in Norway but might well be crucial in other countries.

Perhaps the most important lesson to be learnt from Norwegian experience is that the planning of a major reform of the educational system involves many choices between alternative policies, and that these choices may have a crucial influence on the over-all cost of the reform, and hence on its feasibility and timing. Since many developing countries are faced with a very similar problem to the Norwegian problem, namely how to plan the introduction of an adequate period of nation-wide compulsory schooling, the Norwegian experience can be particularly valuable in focusing attention on the need to understand the relative impact of alternative policy choices, and indeed the need to consider alternatives, before detailed and costly plans are finally prepared.

Appendix I

The equations of the Model

1. $C = W + S + M + A$

Total current cost equals expenditure on wages, salaries and pensions plus expenditure on transport and housing plus expenditure on furniture and books plus other current expenditure.

2. $W = W_L^x + W_L^y + W_P^x + W_P^y$

Wages, salaries and pensions equal wages and salaries in grades 1–6 plus wages and salaries in grades 7–9 plus pensions in grades 1–6 plus pensions in grades 7–9.

3. $T = t_1^x E_1^x + \ldots t_6^x E_6^x + t_1^y E^y$

Total school-hours requirement in compulsory education equals the sum of the total school-hours requirement per pupil in each category of school times enrolment in that category.

4. $W_L^x = (t_1 E_1 + \ldots + t_6^x E_6^x)\, w^x (1 + P^x)$

Wages and salaries in grades 1–6 equal total school-hours requirement in grades 1–6 times wage rate per hour times adjustment for personnel on paid leave.

5. $W_L^y = t^y E^y w^y (1 + P)^y$

Wages and salaries in grades 7–9 equal total school hours requirement in grades 7–9 times wage rate per hour times adjustment of personnel on paid leave.

6–11. $t^x = t_{u1} \ldots t_{u6} + t_r + t_a^x$

Total school-hours requirement per pupil per year in primary schools equals teaching hours per pupil per year in grades 1–6 by class type plus 'pedagogical inspection hours' per pupil per year in compulsory education plus 'administrative hours' per pupil per year in primary schools.

12. $t^y = t_u^y + t_r + t_a^y$

Total school-hours requirement per pupil per year in grades 7–9 equals teaching hours per pupil per year in grades 7–9 plus 'pedagogical inspection hours' per pupil per year in compulsory education plus 'administration hours' per pupil per year in lower-secondary schools.

13–18. $\dfrac{t_u^x = H_1{}^1 + H_1{}^2}{K_1} \ldots \dfrac{H_6{}^1 + H_6{}^2}{K_6}$

Teaching-hours requirement per pupil per year in grades 1–6 schools equals the sum of average number of hours taught in a 'full class' and 'divided class' (net) divided by the average class size, by type of primary school.

19. $T_u^y = \dfrac{(H^{1y} + H^{2y})}{K^y}$

Teaching-hours requirement per pupil per year in grades 7–9 equals the sum of the average number of hours taught in a 'full class' and 'divided class' (net) divided by the average class size in lower-secondary schools.

20. $W_P^x = p^x W_L^x$

Pensions cost in grades 1–6 equals percentage of public expenditure on wages and salaries in primary schools spent on pensions times expenditure on wages and salaries in grades 1–6.

21. $W_p^y = p^y W_L^y$

Pensions cost in grades 7–9 equals percentage of public expenditures on wages and

salaries in lower secondary schools spent on pensions times expenditure on wages and salaries in grades 7–9.

22. $S = S_t + S_h$

Expenditure on transport and housing equals expenditure on transport plus expenditure on housing.

23. $S_h = s_h E_h$

Expenditure on housing pupils equals cost of housing per pupil times number of pupils requiring housing.

24. $E_h = e_h E$

Number of pupils requiring housing equals percentage of pupils requiring housing times total number of pupils.

25. $S_t = s_t E_t$

Expenditure on transport equals cost of transport per pupil times number of pupils requiring transport.

26. $E_t = e_t E$

Number of pupils requiring transport equals percentage of pupils requiring transport times total number of pupils.

27. $M = mE$

Cost of furniture and books equals unit cost of furniture and books in compulsory education times total enrolment.

28. $A = aT$

Other current costs equal other current costs per school-hour times total number of school-hours.

29. $L_u^y = \frac{t_u^y}{O^y B^y}$

Demand for teachers per pupil in grades 7–9 equals total 'teaching-hours' requirement per pupil per year divided by teaching obligation per week times number of school weeks per year in lower-secondary schools.

30–35. $L^x = \frac{t_{u1}^x}{O^x B^x} \cdots \frac{t_{u6}^x}{O^x B^x}$

Demand for teachers per pupil in grades 1–6 equals total teaching-hours requirement for pupil per year divided by teaching obligation per week times number of school weeks per year in primary schools, by school-type.

36. $L^x = (l_1 E_1 + \ldots + l_6 E_6 (1 + P^x)$

Demand for teachers in grades 1–6 equals the sum of the demand for teachers per pupil times enrolment in each type of school times adjustment coefficient for replacement of personnel on paid leave in primary schools.

37. $L^y = l^y E^y (1 + P^y)$

Demand for teachers in grades 7–9 equals the demand for teachers per pupil times enrolment times adjustment coefficient for replacement of personnel on paid leave in lower-secondary schools.

Appendix II

Expenditure on teachers' wages under different combinations of alternatives, primary school

Alternative	*Expenditure on wages (Kr. millions)*	*Demand for teachers*
$a_0\ b_0\ c_0\ d_0\ e_0\ f_0$	400	14 750
$a_1\ b_0\ c_1\ d_0\ e_1\ f_1$	419	14 620
$a_2\ b_0\ c_1\ d_0\ e_1\ f_1$	431	15 040
$a_1\ b_0\ c_2\ d_0\ e_1\ f_1$	465.5	16 240
$a_2\ b_0\ c_2\ d_0\ e_1\ f_1$	479	16 720
$a_1\ b_0\ c_1\ d_1\ e_1\ f_1$	465 (− 5 mill.?)[1]	16 220
$a_2\ b_0\ c_1\ d_1\ e_1\ f_1$	479	16 710
$a_1\ b_0\ c_2\ d_1\ e_1\ f_1$	517	18 020
$a_2\ b_0\ c_2\ d_1\ e_1\ f_1$	532	18 550
$a_1\ b_0\ c_1\ d_2\ e_1\ f_1$	398 (+ 5–10 mill.?)	13 890
$a_2\ b_0\ c_1\ d_2\ e_1\ f_1$	409.5	14 290
$a_1\ b_0\ c_2\ d_2\ e_1\ f_1$	442	15 430
$a_2\ b_0\ c_2\ d_2\ e_1\ f_1$	455	15 880
$a_1\ b_0\ c_1\ d_0\ e_2\ f_1$	457	15 960
$a_2\ b_0\ c_1\ d_0\ e_2\ f_1$	470.5	16 430
$a_1\ b_0\ c_2\ d_0\ e_2\ f_1$	507.5	17 730
$a_2\ b_0\ c_2\ d_0\ e_2\ f_1$	523	18 240
$a_1\ b_0\ c_1\ d_1\ e_2\ f_1$	507 (− 5 mill.?)	17 700
$a_2\ b_0\ c_1\ d_1\ e_2\ f_1$	522.5	18 230
$a_1\ b_0\ c_2\ d_1\ e_2\ f_1$	563.5	19 670
$a_2\ b_0\ c_2\ d_1\ e_2\ f_1$	580.5	20 250
$a_1\ b_0\ c_1\ d_2\ e_2\ f_1$	434 (+ 5–10 mill.?)	15 150
$a_2\ b_0\ c_1\ d_2\ e_2\ f_1$	447	15 590
$a_1\ b_0\ c_2\ d_2\ e_2\ f_1$	482.5	16 840
$a_2\ b_0\ c_2\ d_2\ e_2\ f_1$	497	17 330

1. Estimates of expenditures on conveyance.

Appendix III

Glossary

1. *Hours taught* An 'hour taught' is one 45-minute period taught by one teacher. Hours taught must be expressed in terms of the size of the pupil group, e.g. hours taught in a full class, or hours taught in a divided, or combined class. The model distinguishes between hours taught in a full class (H^1) and *net* hours taught in a divided class (H^2).

2. *Teacher-hours* A 'teacher-hour' is one period of teaching, with allowance made for the size of pupil group. If pupils are taught together, in a *full class*, one hour of pupil-time = one teacher-hour. If the class is divided in *two divided classes*, one hour of pupil-time = two teacher-hours. If two full classes are taught together as a *combined class*, one hour of pupil-time = half a teacher-hour.

Thus, if the pupils in one grade spend 30 hours a week in school, and spend two hours in a divided class, (i.e. one full class divided into two groups) and one hour 'combined' with another full class, the total number of teacher-hours, per pupil, is calculated as follows:

27 hours in full class	= 27	× 1	= 27.0
2 hours (net) in divided class	= 2	× 2	= 4.0
1 hour (net) in combined class	= 1	× 1/2	= 0.5

3. *School-hours* The total number of 'school-hours' per pupil (t) is equivalent to the total time spent by the staff in teaching (tu) plus administration (ta) plus pedagogical supervision (tr).

4. *Teaching obligation* The 'teaching obligation' of a teacher (O) is the total number of periods the teacher must spend, per week, in teaching, administration or pedagogical supervision. According to Norwegian regulations, if a teacher in a primary school has to teach more than one grade in a single class, his teaching obligation is correspondingly reduced.

Barbados *14*

Marginal costs for marginal decisions: the case of team teaching

prepared by Richard M. Durstine *and* Barclay M. Hudson

This study was prepared by Richard M. Durstine and Barclay M. Hudson of the Harvard Graduate School of Education.

Introduction

Early in 1968 the authors of this paper were invited by the 'Council of Three' of the Barbados Team Teaching Project (BTTP) to study the costs of the Project. By this was understood both analysis of actual expenditures and a projection of what it would cost to continue and expand the activity of team teaching after the termination of support by the Ford Foundation. It proved attractive for two reasons to approach this work from a view point broader than that of the BTTP alone. Firstly, the need to project costs under a variety of future conditions made it desirable to make cost projections with considerable flexibility. Secondly, it appeared possible to develop means to describe and estimate costs that would be of use in situations well beyond the BTTP and Barbados itself.

The cost model described and illustrated below thus has its roots in the BTTP, but is also relevant to other situations, in so far as they are analogous. We believe the range of analogous situations to be quite broad, though the work as presented here has limitations based on the needs and possibilities that arose in the BTTP. We will note some of these limitations as they become evident in this discussion. We think that many of these can be removed by straightforward extension of this work, but will not speculate in detail on that possibility.

Of all the features desirable in a cost model perhaps the most important is *relevance to problems* which education officials need to solve. The model used in the Barbadian cost study is designed with the administrator in mind. Specifically it is intended: (i) to work both for aggregated and disaggregated situations; (ii) to adapt readily to hand computation, but at the same time to be readily convertible to use by computer; (iii) to be sufficiently simple that hand computations do not require excessive effort; (iv) to allow for ready computation of the implications of changes in programme specifications or external factors, so that simple changes do not require full recomputation; (v) to allow for easy visualization of the relationships among its component parts and between them and the situations they seek to represent.

The above requirements have by and large been fulfilled, owing in no small part to the fact that they were established after the model had been designed and tested. In any event, the main criterion was—and remains—the possibility of using costs as an aid to decision-making and to the control of implementing decisions. Thus the above requirements relating to adaptability and simplicity of use are fundamental.

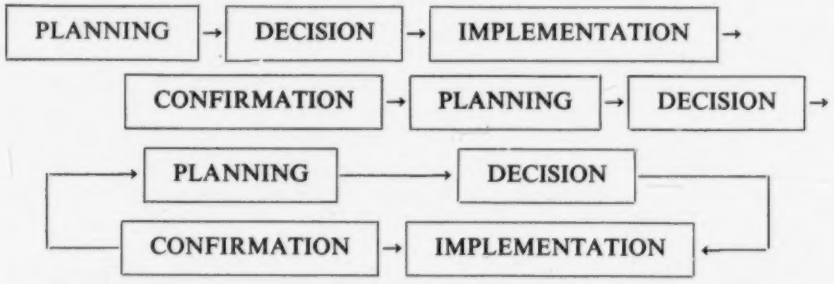
In the interest of making this paper of use to educational planners and administrators, we have tried to link it to the 'planning-implementation process' described below. We have also tried to state clearly what can and cannot be expected.

The planning-implementation process

In the planning-implementation process we include: planning, decision, implementation and confirmation of the extent to which expectations of performance are

fulfilled. It is understood that real processes rarely conform to this ideal. They tend to be indistinctly defined; they are hampered by overburdened staffing; and they suffer from the intrusion of events and influences that cannot be taken into account beforehand.

Nevertheless, the concept of a sequential process of planning, decision, implementation and confirmation is a useful framework for describing reality. It may also provide a helpful norm for designing and evaluating possible changes in the operation or composition of a social system like education. This planning-implementation process is both sequential and cyclical, as suggested by the diagram below.



In this diagram the blocks represent activities. The arrows suggest their sequence and the flow of information and influence among them. The intention is to suggest that the outcome of even the most routine process can be improved by explicit consideration of the future ('planning') and by thoughtful examination of the past ('confirmation').

The planning-implementation process implies four important roles for information about costs. First, they are a natural part of the *description* of most activities. It should be pointed out, however, that budget statements by themselves can present a misleading picture of actual costs. Budget categories to which charges are made do not always correspond to actual use of funds. Likewise, inputs are sometimes available without corresponding expenditure and records may thus under-estimate the total resources that are in fact used.

A second role of costs is to help test the *feasibility* of plans. Again, one must use caution about extrapolation from one situation to another. For example, it is important to distinguish the special overhead costs of a pilot project and to recognize that its benefits may be difficult to reproduce on a larger scale, under less controlled conditions. Large-scale programmes may provide economies of scale but they can also run into bottlenecks. Trained staff, which might have been supplied at below cost in a pilot project, may be unavailable at any price when the need is doubled or tripled.

Third, cost information can help provide *confirmation* as to whether intentions have been carried out. In this, significant underspending can be as indicative of trouble as is significant overspending. Comparison of expenditures with budgets can be of use: (a) in identifying points of mis-estimation; (b) in identifying changes

in plans (intentional or otherwise); and (c) as a means for finding points where better control is needed.

Finally, information about costs can be of use in *evaluation* and *choice* among alternative courses of action. At the simplest level, one can on the ave hand compare costs of what executives report to be equally desirable alternatives; or on the other hand construct alternatives of equal cost and ask executives to judge the most suitable. The most difficult task is ultimately not the cost analysis but rather the evaluation of benefits.

There exist highly developed tools and procedures for dealing with the objective aspects of cost and practically none for dealing with the subjective aspects of benefit. Nor is this situation likely to change, since many subjective questions are clearly of such a nature that measurement and precision would be highly inappropriate to them.

This paper devotes extensive attention to costs, since this is where objective information is available. Moreover, a clear exposition of costs can be useful to the subjective evaluation of benefits, as it provides a framework for spelling out alternatives.

Marginality of costs and decisions

Almost all decisions, and hence almost all costs, are best conceived as marginal, that is, as adjustments to an already existing situation. One seldom makes a decision that is not in fact a modification of some larger scheme. Similarly, there is seldom an expenditure that truly stands by itself. This view point is of course not applicable in all cases. But it is appropriate to the particular examples to be discussed in this paper, as well as to many other practical cases of decision and action.

I. The educational system

The literacy rate of Barbados is reported to be above 90 per cent. This is one result of the country's high population density, which permits every child to live within walking distance of one of the island's 144 primary schools. Ninety-seven per cent of primary-level pupils attend schools that are government-operated, and 76 per cent of secondary-level pupils are in government schools. In addition, the majority of independent schools receive public financial support.

Children aged five to seven attend *infants' school*; those from seven to eleven attend *junior school*. Secondary education begins after age eleven, when the child may follow one of several alternatives: (a) he may continue his studies in an *all-age school*, which comprises infant, junior and senior levels to age fourteen; (b) if he

passes his examinations with a high enough mark, he is eligible to attend a secondary *grammar school* which pursues a full academic course to age nineteen and prepares him for examinations equivalent to those administered to British children; (c) another option is secondary *comprehensive* school (formerly known as secondary modern school) which provides education to age seventeen; (d) finally, there is a limited number of institutions providing *vocational training*, including technical school, apprenticeship school and domestic science centres.

Table 1 compares enrolments with school-age population at the primary and secondary levels. The tapering-off of enrolment at the post-primary level reflects three things: (i) the varying terminal age of the different secondary tracks; (ii) the loss of students within each of the tracks; and (iii) the growth of enrolments over time.

TABLE 1. School-age population in Barbados and enrolments by age

Age	1965 population	1966/67 estimated enrolments			Enrolments[1] as percentage
		Public	Private[1]	Total[1]	
Primary					
5	6 160	5 333		5 513	89
6	6 680	6 017		6 220	93
7	6 780	6 335		6 548	97
8	6 870	6 040		6 243	91
9	6 910	5 467		5 651	82
10	6 840	5 866		6 064	87
11	6 520	4 906		5 071	78
Totals	46 760	39 964	1 346	41 310	88.2
Secondary					
12	6 370	4 897		5 642	89[2]
13	6 210	4 331		5 076	82
14	6 040	3 751		4 496	74
15	5 850	2 180		2 925	50
16	4 630	1 422		2 167	47
17	4 440	1 059		1 804	41
18	4 270	619		1 364	32
19	4 080	464		1 209	30
Totals	41 890	18 723	5 960	24 683	58.9
Grand totals	88 650	58 687	7 306	65 993	74.3

1. Data are not available on the distribution of *private* enrolments within either the primary or secondary level. The distribution shown in the 'Total enrolment' column assumes that private enrolment distribution is identical to the public at the primary level and that private enrolments are uniformly distributed at the secondary level. Private secondary schools are mostly grammar schools—to age 19—with relatively low drop-out rates. (See Barbados, *Digest of Education Statistics 1966-1967*, Tables L-4 and P-10.) This assumption probably overstates enrolment in the later years of the secondary level.
2. The high index of enrolments at age 12 (relative to age 11) probably represents errors in reporting.

NOTE Figures include both public and private enrolments. Not included are enrolments at the Housecraft Centre (36 total), domestic service and nurses' classes at the Barbados Evening Institute (715 and 26 respectively) or adult education classes (966 total enrolment).

SOURCE Barbados, *Digest of Education Statistics 1966-1967*, Tables P-1, P-2, FP-1, X-2.

TABLE 2. Public expenditures on education (EC dollars)

Year	
1953	2 139 000
1960	3 998 000
1966	11 622 000

SOURCE 1953: United Nations, *World Survey of Education*, Vol. II, p. 1181.
1960: United Nations, *World Survey of Education*, Vol. IV, p. 1290.
1966: Barbados, *Digest of Education Statistics 1966-67*, Table F-8.

At the post-secondary level, teacher training is provided by Erdiston College, established in 1948. There is also a Technical Institute. The University of the West Indies (UWI) has a rapidly growing campus in Barbados, established in 1963. Education is free at all levels.

Government expenditures on education have risen rapidly, as shown in Table 2. These figures include capital outlays, which amounted to 15 per cent of the total in 1966. In 1966, all but 2 per cent of government expenditures on education were made through the Ministry of education.

Enrolments have also risen steadily, as shown in Table 3. Among other things this table illustrates the minor role of private education; the growth of post-secondary technical education; and the recent opening of UWI's Arts and Sciences College. Not shown are enrolments at Codrington Theological College (42 in 1956), or adult education enrolments. During the decade 1956-66, it can be seen that primary enrolments increased 39 per cent, secondary enrolments 87 per cent, and teacher-training enrolments at Erdiston College 26 per cent.

The fact that expenditures have risen faster than enrolments suggests in part an increase of inputs per student. At present about 2[illegible] per cent of the government's total budget is devoted to education, and this represents about EC$ 100 per pupil.

The Ministry of education has no special planning office and it has not chosen to divert qualified staff to developing an educational 'plan'. Planning does take

TABLE 3. Enrolment trends

	Primary		Secondary			Higher	
Year	Private	Public	General	Vocational	Technical	UWI	Erdiston
1951/52	25 193		10 713		—	0	36
1956/57	—	28 298	11 660	483	103	0	116
1960/61	—	32 781	13 953	749	89	0	127
1966/67	1 346	39 964	22 660[1]		462[1]	108	146[2]

1. These figures do not correspond to the total in Table 1. See footnote 1 to that table.
2. Figure applies to 1964/65, from Barbados, *Digest of Education Statistics 1964-1965*, Table FP-4.

SOURCE 1951/52: UN *World Survey of Education*, Vol. II, p. 1179.
1956/57: Ibid., Vol. IV, p. 1289.
1960/61: Ibid.
1966/67: Barbados, *Digest of Education Statistics 1966-1967*, Tables P-1, FP-1, 2, 5.

place, however, in the sense that the Ministry must be responsive both to the Ministry of finance and to the Parliament in setting out, justifying and estimating the costs of its annual priorities. The major limitation on long-range planning would appear to be lack of personnel. Precise long-range planning would face problems of uncertainty about the future course of the island's economic development and the additional problem of instability of the emigration-prone labour force. At present planning is primarily short-range and carried out by administrators. Furthermore, it usually centres on the choice between marginal alternatives within an on-going programme whose major parameters are assumed to be constant. This has important implications for the uses and design of cost analysis. It should be emphasized, nevertheless, that this type of planning has not excluded the possibility of introducing major reforms, such as comprehensive schools, or the experiment with team teaching.

A major distinction is made between 'trained' and 'untrained' teachers. Trained teachers are those who have completed the two-year course at Erdiston College. In 1966/67, trained teachers made up 50 per cent of the primary school staff and 35 per cent of the secondary school staff. Among untrained teachers a distinction is made between 'supernumeraries', who have received formal appointments after one or two years of teaching experience, and 'acting teachers', who are recent secondary school graduates, and typically enter the teaching force at age nineteen.

II. The Barbados Team Teaching Project

The Barbados Team Teaching Project was conceived as an experiment in applying to a developing country a new educational programme that had been conceived and nurtured in an advanced educational system. Team teaching was developed in the United States in the early 1950s and was designed to encourage interaction and growth among teachers of differing qualifications and abilities. It is based on the recognition that teaching requires a range of skills and that different teachers have relative strengths and weaknesses in different fields and methods of teaching. By forming teams of teachers, the most experienced and able can extend their responsibility over a large number of children; the newer ones can receive guidance; and teacher aides can take over tasks which require relatively little training, thus freeing more qualified personnel to specialize in tasks that call for their particular skills.

Teacher specialization permits a more flexible programme, including large and small group instruction, independent study by students, and attention to special problems arising with individual children. It also allows more expert use of special equipment and encourages more initiative on the part of individual teachers. Al

this requires co-ordination within the teaching team. At least once a week, therefore, all the team members, including the teacher aides, meet to plan lessons. These planning sessions provide not only an outline of schedules and tasks but an opportunity for each teacher to develop intellectually and professionally through contact with other teachers.

1. *Description of the project*

The Barbados Team Teaching Project was financed by the Ford Foundation and involved collaboration of the Barbados Ministry of education, the Institute of education of the University of the West Indies and Harvard University, through the Graduate school of education's Center for Studies in Education and Development. The purpose of this collaboration was to introduce team teaching by way of a pilot programme, to train key personnel, to evaluate short-term results, develop modifications if necessary, and to document the problems and achievements that would facilitate possible experiments along similar lines in other countries.

Although team teaching is not cheaper than conventional teaching, it appears to be a cheap means of achieving considerable improvement, far less expensive, for example, than reducing the pupil/teacher ratio. A careful examination of cost was thus an objective of the project and provides the basis for this case study.

The BTTP covers the five-year period 1965–69 and is under the joint control of the three participating institutions. The budget was set at US$ 297,500. Of this total about 32 per cent was allocated to overhead costs (mainly evaluation); 25 per cent for a resident consultant from Harvard; 10 per cent for a Barbadian executive secretary; 8 per cent for training of Barbadian personnel in the United States; 5 per cent for in-service training during vacation workshops; 5 per cent for salaries of teacher aides; 7 per cent for building modifications and materials and 7 per cent for contingencies and miscellaneous purposes.

This pattern of allocation was subject to revision but no modification was found necessary, except on minor points to be noted later. There were five pilot schools. Three were 'all-age' schools (ages 5–14) and two were primary schools (ages 5–11). Two of these were originally chosen as control schools but it proved impossible to withhold the experimental programme from them due to the strength of local demand for team teaching. Teachers from other, non-teamed schools have attended in-service workshops and consequently interest in the programme has remained strong.

Within the experimental schools a typical team consisted of four teachers: one team leader and a second trained teacher, plus two teachers with varying degrees of experience but without advanced training. Each team handled 160 children and since the pilot schools had an average enrolment of 650 children (about twice the national average), there were typically four teams per school. Each school had in addition one head teacher (i.e. school principal) and one teacher aide; both of these positions combine administrative with teaching functions.

The head teacher is part of the regular school staff while the teacher aide was assigned only to the project schools.

The training of teachers represents perhaps the most permanent form of investment in the team teaching programme. In assessing the costs of the training programme we also had an opportunity to measure the cost of wastage among the teachers who received such training.

2. *In-service training (workshops)*

128 persons from the pilot (teamed) schools have attended the five vacation-period workshops since the beginning of the project.[1] The cost of in-service training has been approximately US$ 25 per participant per week. (The workshops last from four days to two weeks.) In contrast, overseas training (averaging about four weeks per participant) cost about US$ 205 per week.

Of the pilot school staff who have attended workshops over the last three years, 42 per cent were absent as of June 1968. Ten per cent were on temporary leave, mainly to receive formal training at Erdiston College; 9 per cent were teaching at other (unteamed) schools; 11 per cent had left teaching and 12 per cent had emigrated. Teachers who leave teaching tend to be younger and have attended fewer workshops (2.6 weeks as against an average of 3.4 for all participants). The majority of these are untrained (i.e. they have not taken formal courses at Erdiston), and with neither job security nor high salaries they tend to be drawn into local private enterprise. In contrast, the older and better-trained teachers tend to leave only if a substantial offer is made from abroad.

The five pilot schools differ in the degree to which their workshop participants are subsequently lost to private enterprise or emigration. The proportion of loss varies from 12 to 29 per cent of those who received in-service training, depending on the school.

3. *Training in the United States*

Twenty-eight participants have been trained overseas under the auspices of the Team Teaching Project.[2] The cost of overseas training for a single participant has been about US$ 1,350 for a six-week course, US$ 800 for a four-week observation tour or US$ 250 for a two-week observation tour, not including travel.

Future savings on overseas training might be realized in the following ways:

1. Greater use might be made of the regular Ministry budget that provides travel for staff on leave. Such overseas training during leaves of absence is encouraged as a normal part of the Ministry's leave policy.
2. Future training and utilization of staff might be planned so as to increase the 'reach' of expensively acquired skills. In only one case has formal overseas

1. As of spring 1968.
2. As of September 1968.

coursework been provided to a school staff member for the purpose of making that person a specialist and part-time consultant to the team teaching programme at large. This practice might be further encouraged.

4. *Modifications to original Project plans*

The outlines of the Barbados Team Teaching Project were drawn up in the summer of 1964. The scope, purpose and costs anticipated at that time have proved quite consistent with actual events. Since considerable care and forethought went into the planning of the Project, it is interesting to make note of major departures that have occurred from original intentions. Some of these modifications are in a sense a measure of what was not anticipated while others are a measure of what was learnt from the experience. These modifications were as follows:

(a) *Secondary schools not included.* The original intention was to begin with two experimental primary schools and then add two more at the secondary level. In addition, there was to be an equal number of control schools at each level. Instead, both of the primary control schools became teamed, due to the strong demand for the innovation by the individual schools. For similar reasons a fifth primary school was also teamed. This had two important implications: first, it meant a loss of experimental controls, making it more difficult to substantiate the effects of team teaching relative to the regular system. Second, it meant a loss of experience in dealing with team teaching in the Barbadian secondary schools, which might have offered a richer variety of curricula, staffing, administration and physical environment to experiment with.

(b) *Advisory committee not formed.* It was originally intended to form a committee of advisers to the project which would have included representatives of the Ministry of education, UWI's Institute of education, Erdiston Teacher-training college, the Teachers' Union and secondary school officials. This committee was never organized, however, and its functions were implicitly relegated to the co-ordinating efforts of the Executive secretary and the foreign resident consultant.

(c) *Full-time Executive secretary replaces second foreign resident consultant.* The original plan was to have a half-time Executive secretary provided by the Ministry (though paid by the Project), together with two foreign resident consultants. Instead the Executive secretary became full-time and only one foreign consultant was brought in. This shift from foreign to local staffing proved satisfactory and resulted in considerable financial savings. Whereas a foreign resident consultant costs about US$ 20,000 per year, a full-time Executive secretary costs about US$ 8,000, including office and secretarial expenses.

(d) *Teacher aides limited to one per school.* As originally conceived there was to be *at least* one teacher aide per school, with the standard being one aide for every two teams (assuming approximately four teachers and 160 pupils per team). At

present, however, there is only one aide for every four teams (except at one school which has two aides—one 'clerical' and one 'teaching'). This use of only one aide per school was apparently made in the interests of economy, since teacher aide salaries are a major item of the future on-going costs of team teaching. Nevertheless, teacher aides release the head teacher of a school from relatively menial functions, enabling him to undertake a supervisory role throughout the school, more in line with his training and experience. A properly used teacher aide—whose salary runs about US$ 940 per year—can release the services of a highly skilled supervisor whose value in terms of salary is in the range of US$ 3,650.

(e) *Teachers' rooms less expensive than anticipated.* Building modifications to provide workrooms for teachers were estimated at US$ 3,000 per school. Actual construction took place at only two schools, the other schools requiring only minor changes to existing premises. Average costs were in fact only about US$ 230 per school. Unspent building funds have been largely expended on furniture (about US$ 640 per school) and equipment (about US$ 320 per school).

(f) *Consumable materials per pupil slightly less than anticipated.* The original intention was to supply US$ 1.00 per pupil in books and consumable materials. In fact, due largely to the addition of three experimental schools, only about US$ .80 per child yearly has been spent on consumables and books (about US$ .45 on books and US$ .35 on consumables).

(g) *In-service training somewhat more expensive.* The cost of in-service training was originally estimated at US$ 3,000 per year. Actual expenditures have been close to US$ 4,500 per year, including both spring workshops and summer workshops.

5. *Efforts at evaluation*

It was originally intended to provide the project with a 'tough-minded' overseer whose role would have been to specify just what could be claimed for the project in the way of successes and failures. He was to have been concerned, among other things, with a study of the psychological impact of team teaching on teachers and pupils in general and the effect of the Barbadian cultural setting on the country's ability to utilize team teaching.

The fact that such a person was not eventually brought in indicates that some of the evaluative objectives have been revised, if not intentionally at least in fact. The main quantitative evaluation is being carried out by the UWI, which is attempting to measure pupil achievement, some aspects of teacher competence and the attitudes of teachers, pupils and parents toward team teaching.

Other evaluation efforts include three major benchmark surveys; a series of reports from both the Executive secretary and the resident consultant; periodic

meetings by the Council of Three (executive board of the BTTP) and visits to Barbados by more than a dozen *ad hoc* consultants.

6. *Likelihood of expansion of team teaching*

As of January 1969, the outlook for extension of team teaching to other schools in Barbados seemed favourable. However, no firm policy decision had been taken while awaiting two developments: first, the preparation of a final evaluation of the pilot programme;[1] and secondly, the possible integration of team teaching into a more comprehensive effort to improve educational standards throughout Barbados. Such integration would tend to enhance the effectiveness of team teaching since it could then relate better to the teacher-training programme at Erdiston, flexible design of new facilities, training of officials during normal overseas leave, more imaginative approaches to development of curriculum materials and new priorities for purchasing equipment and materials.

If and when expansion takes place, the need to train team leaders almost certainly means that it will be phased in gradually, e.g. five new schools in the first year, five or ten more in the second and so on. Since a single team can handle about 160 students, team teaching evidently works best in larger schools, where one team can work with a relatively narrow age span.

Apart from the Minister of education, the principal initiative for planning future expansion of team teaching has been with the Project's Executive secretary who, in early 1967, prepared a 'Plan for extending the Team Teaching Project beyond the experimental stage'. This plan emphasized a General School Improvement Programme and envisaged the eventual teaming of every 'all-age' school (ages 5–14) with 400 or more pupils and every 'primary' school (ages 5–11) with more than 320 pupils, a total of 52 schools. The memorandum suggested priorities in the allocation of team teaching funds, particularly to teacher aide salaries, equipment (such as duplicators) and training. A more recent report by the present Executive secretary reiterates these guidelines, and gives additional focus to priorities in terms of specific schools to be phased in and to the role of local supervisors and consultants already trained in team teaching.

Enthusiasm for team teaching has been shown by the Ministry's regular staff of school supervisors. Additional interest has been generated by attendance at in-service training workshops of teachers from non-teamed schools.

Once the final evaluation of the qualitative effects of team teaching is completed, a decision can be made as to whether or not the programme is to be expanded, and whether or not this expansion is to be part of a broader programme to improve educational quality. It is at that point that the cost model presented in this paper will be of greatest usefulness, for it provides the means of estimating quickly the budgetary implications of alternative strategies, whether one is dealing with marginal policy questions, or with major strategic decisions.

1. For mid-1969.

III. A model for projecting costs

Carefully made estimates of cost were included in early plans for the Team Teaching Project. These helped both to define activities and to estimate the expenditures that would be experienced. In the course of the Project these budgets were realized with considerable precision; the reasons for the major deviations are easy to understand.

One useful feature of the earlier cost estimates deserves mention. This is the grouping of costs of the Project under four headings:[1]

N costs—Normal or regular costs of running the schools in the Project;
X costs—Additional permanent costs due directly to the adoption of a system of team teaching;
Y costs—Costs of launching and developing the pilot Project;
Z costs—Costs of assessment of the Project and of related research.

Greatest attention and detail in the subsequent discussion is given to the X costs, since they are the ones that will be of most relevance to the continuation of team teaching in the long run. N costs are for the most part not considered, being outside our purview. The Y and Z costs are of interest historically but are less so in making projections for the future.

Description of the model

For the moment we will consider the cost model in the abstract. At a later point it will be illustrated in terms of the costs of extending team teaching in Barbados. Before that, for illustrative purposes, a simple example will be used as a vehicle for discussion. This has been chosen to emphasize the *method* of cost projections, rather than their *substance*.

The basic principles used are simple in the extreme: (i) that total cost is equal to the quantity of input times unit cost of the input. That is, six mangoes at six cents each costs 36 cents; (ii) that often the quantity required of one thing bears a linear relationship to the quantity used of some other thing. That is, for every six mangoes we need twelve (disposable) napkins, or two napkins per mango.

The above two rules serve as the basis for almost all the cost computations made in the following pages. They must of course be applied with care. In most cases they will be true 'locally' (i.e. for limited ranges of the quantities being considered). Outside the range where a given relationship holds, a great many further cases can be approximated by applying the above very simple principles locally as many times as necessary and by providing for continuity among the local estimates.

When we buy six mangoes at six cents each we are buying a quantity (Q) of something at a fixed cost (U) per unit of that thing. The cost (C) of all six mangoes

1. Beeby, C. E. and others in early working documents of the Barbados Team Teaching Project, 1964.

is the product of Q times U, so: QU = C; or, in numbers: 6 mangoes × 6 cents/mango = 36 cents.

Two simple cautions are needed here. First, the above is true only as long as the unit cost U does not vary. Second, it is helpful to add to the letters C, U and Q to remind ourselves that we are talking of mangoes and not something else.

$$C(\text{mangoes}) = Q(\text{mangoes})\ U(\text{mangoes})$$
$$C(\text{MNG}) = Q(\text{MNG})\ U(\text{MNG})$$
$$C_a = Q_a U_a$$

In this paper we have found it useful to employ all three types of notation, but in dealing with particular programmes like team teaching the second one is usually most practical.

Most expenditures do not exist independently, in that most inputs into a programme require complementary inputs in order to make best use of them. If two napkins are consumed in the process of eating each mango, the total quantity of napkins to be used is

$$Q(\text{napkins}) = P(\text{napkins/mango})\ Q(\text{mangoes})$$
or
$$Q(\text{NPK}) = P(\text{NPK/MNG})\ Q(\text{MNG})$$
or
$$Q_b = P_{ab} Q_a$$

where NPK stands for napkins, as does the subscript letter b. The symbol P is called the *policy* relating quantity of napkins to quantity of mangoes. As the word is used here, a *policy* represents a simple and consistent relationship between quantities of various things. Such relationships may result from stated policy, tradition, physical necessity, or legal requirement, among other things. Such relationships may in fact be complicated and ill-defined and sometimes are not identified at all. One of the functions of cost analysis must therefore be to clarify policies which have a bearing on future programme costs.

The importance of policies in our model is that they provide a method of treating costs as something tied directly to decision-making. The model does *not* attempt to say 'a programme must take inputs a, b and c into account'. Rather, it says '*if* you are interested in a or b or c, the cost implications will be thus'.

Returning now to the example, the cost of napkins needs next to be determined. Total cost evidently equals unit price times quantity, but the quantity is determined by the quantity of mangoes and by the policy relating numbers of napkins and mangoes. Thus:

$C(\text{napkins}) = Q(\text{napkins})U(\text{napkins}) = P(\text{napkins/mango})Q(\text{mangoes})U(\text{napkins})$
or
$C(\text{NPK}) = Q(\text{NPK})\ U(\text{NPK}) = P(\text{NPK/MNG})\ Q(\text{MNG})\ U(\text{NPK})$
or
$C_b = Q_b C_b = P_{ab} Q_a C_b$
or, in numbers
24 cents for napkins = (2 napkins per mango) × (6 mangoes) × (2 cents per napkin).

The important thing about this form of cost description is that the policy statements appear explicitly in the equations.

The final step is to compute cost of the total activity. We are assuming that mangoes and napkins are the only parts to cost anything. We give the name 'resultant cost' and the code letter R to the cost of the mangoes including all those things that consumption of mangoes entails. So the resultant cost will be

$$R(\text{mangoes}) = C(\text{mangoes}) + C(\text{napkins})$$

or

$$R(MNG) = C(MNG) + C(NPK)$$

or

$$R_a = C_a + C_b$$

or, in numbers

60 cents (total for the activity of eating mangoes) =
36 cents (for the mangoes themselves) + 24 cents (for the napkins)

The very simple ideas described above are all that is necessary to compute costs of very complex programmes, even when many policy alternatives are at stake. This will be demonstrated in the following section.

IV. Application to the team teaching example

The steps needed to prepare an estimate of the costs of a programme are as follows:

1. Identify the activities that make up the programme, being specific as to the measurable costs of all items. Identify the 'policies' which apply to each item. In particular, distinguish between: (1) the 'intrinsic' cost of an item; and (2) the derived costs of additional inputs which the item incurs. This was discussed above.
2. Confirm that this structure of quantities and policies is appropriate for the kinds of decisions the model will be applied to, with special attention to possible differences between the conditions of past and future programmes.
3. Determine the *unit* costs of the individual components that make up the activity. Compute the total cost of the individual parts of the activity, and of the activity as a whole.
4. Confirm that these results are reasonable and acceptable. Otherwise, discard and adjust them.

1. *Description of the example case*

Future costs of team teaching in Barbados have been largely derived from policies inherent in the pilot project. Some modifications have been introduced in the course of the on-going evaluation of the project and suggestions for future policies

have been made by the former resident consultant. The resulting structure of policies is summarized in Table 4.

The measurable inputs to the team teaching activity are listed in the first three columns. Their description includes the units of their measurement and a three-letter code or abbreviation. The fourth column gives the 'policies' in terms of which the activity is described. These are the proposed focus for future decision-making. The fifth column of Table 4 provides some remarks on how and why the various policies were chosen.

As will be seen, it is possible to evaluate any number of examples from a single initial computation. The exact composition of the first example is thus not very important, since it can be easily modified. Nevertheless, an attempt has been made to construct a case consistent with existing capabilities and expectancies.

For the purposes of the example, team teaching activity is defined in terms of a Project (PRJ) made up of four types of schools. The schools comprise those (SC1) in their first year of team teaching; those (SC2) in their second year; those (SC3) in their third, fourth and fifth years; and those (SC4) in their sixth and subsequent years. Each type of school is staffed with a head teacher (SS1), senior assistants (SS2), trained teachers (SS3), supernumeraries (SS4), and acting teachers (SS5) according to a fixed pattern, described in Table 4. These figures were derived from national averages of Barbadian primary schools (1966/67) and from the composition of the staff in the five teamed schools.

Supervision in the example is provided by one Executive secretary (SP1) for the activity as a whole and as many field supervisors (SP2) as are needed to satisfy the following: one for each five new schools (SC1); one for each ten SC2; one for each fifteen SC3; and one for each twenty SC4, up to a total of one for all SC4 together. Fractional time spent on field supervision is considered likely and appropriate. The field supervisor(s) would replace the former resident consultant. Supervision would be greatest during the period of development of each school as a team teaching school, culminating eventually in a very low intensity of supervision, after team teaching had become well established in the system as a whole. This anticipates the eventual take-over of team teaching supervision by the regular supervisory staff of the educational system. Each team teaching field supervisor is presumed to receive six weeks of training (TNG) overseas at the time of his appointment. In the interest of economy, no overseas training is anticipated in addition to this.

For the sake of having average figures to use in computing costs, each school is postulated as having an enrolment of 560 except for the five pilot schools which in fact have a larger than average enrolment of 650. In the first years of teaming only one team—with 140 pupils (PPL)—will exist in each school. In subsequent years the school will be fully teamed.

It is recognized that these figures will vary considerably from case to case. They represent averages consistent with national and Team Teaching Project experience. Such average figures are useful and appropriate for budgeting and decision-making, though clearly not descriptive of individual cases.

An average pupil/teacher ratio of 39 is used throughout. One teacher aide

TABLE 4. Description of inputs and policies defining team teaching activity

Code name	Name of input	Units of measure	Policies defining activity	Remarks
PRJ	*Project*	Project year		Refers to one year's operations.
SCL	*School*			
SC1	School: 1st year of teaming	Schools	P(SC1/PRJ) = 5	Example case assumes five new schools added in 1969/70.
SC2	School: 2nd year of teaming	Schools	P(SC2/PRJ) = 0	
SC3	School: 3rd-5th year of teaming	Schools	P(SC3/PRJ) = 5	Present five pilot schools.
SC4	School: After 5th year	Schools	P(SC4/PRJ) = 0	
TMS	*Teams*	Teams	P(TMS/SC1) = 1 P(TMS/SC2) = 4 P(TMS/SC3) = 4 P(TMS/SC4) = 4	Only one team is formed in first year the school enters the programme. In subsequent years the school is fully teamed.
PPL	*Pupils*	Pupils teamed	P(PPL/SC1) = 140 P(PPL/SC2) = 560 P(PPL/SC3) = 650 P(PPL/SC4) = 650	Enrolment = 560; one quarter teamed. Enrolment = 560; fully teamed. Actual enrolment of pilot schools. Allows for long-term growth in average size of newly teamed schools.
WKS	*Workshops*			
WK1	Summer workshop	Two-week session	P(WK1/PRJ) = 1	
WK2	Spring workshop	One-week session	P(WK2/PRJ) = 1	
TNG	*Overseas training*			
TN1	Trips overseas	Trips	P(TN1/SP2) = 1	Overseas training is assumed to apply only to field supervisors. Other personnel receive in-service training at workshops.
TN2	Weeks overseas	Weeks	P(TN1/SP2) = 6	
SPV	*Supervisory personnel*			
SP1	Executive secretary	Full-time person	P(SP1/PRJ) = 1	
SP2	Field supervisor	Full-time equiv.	P(SP2/SC1) = 0.2 P(SP2/SC2) = 0.1	Post not at present existing. Supervision requirements diminish as

			P(SP2/SC3) = 0.0667	school accumulates experience in team
			P(SP2/SC4) = 0.05	teaching.
SP3	*Secretarial staff*	Full-time equiv.	P(SP3/SP1) = 1	
			P(SP3/SP2) = 0.5	
CNS	*Consultants*			
CN1	Local consultants	Consultant-days	P(CN1/WK1) = 160	Ten days, 16 consultants per day.
			P(CN1/WK2) = 80	Five days, 16 consultants per day.
CN2	Foreign cons.-trips	Consultant-trips	P(CN2/WKS) = 1	One foreign consultant per workshop.
CN3	Foreign cons.-days	Consultant-days	P(CN3/WK1) = 10	One foreign consultant per workshop.
			P(CN3/WK2) = 5	One foreign consultant per workshop.
SSC	*Staff of schools*			
SS1	Head teacher	Persons	P(SS1/SCL) = 1	Costs of SSC are borne by regular
SS2	Senior assistant	Persons	P(SS2/PPL) = .005	Ministry budget and incur no cost to Project.
SS3	Trained teacher	Persons	P(SS3/PPL) = .00615	Teacher/pupil ratio for each category
SS4	Supernumerary	Persons	P(SS4/PPL) = .0055	of teacher has been derived from
SS5	Acting teacher	Persons	P(SS5/PPL) = .009	national statistics for 1966/67 and from the pilot school data of June 1968.
STM	*Staff of team*			Most team staff are same as school staff (SSC)
ST1	Team leader	Persons	P(ST1/TMS) = 1	
ST2	Team member	Persons	P(ST2/PPL) = .02565	Teacher/pupil ratio of 39:1 includes ST1 and ST2.
ST3	Teacher aide	Persons	P(ST3/SCL) = 1	One aide per school. ST3's are not included in SSC, hence paid by Project.
SWK	*Staff of workshop*			
SW1	Workshop manager	Person-days	P(SW1/WK1) = 10	
			P(SW1/WK2) = 5	
SW2	Participant trainee	Person-days	P(SW2/WK1) = 800	One hundred trainees for 8 days.
			P(SW2/WK2) = 400	One hundred trainees for 4 days.
BDG	*Building modifications*	EC dollars worth	P(BDG/SC1) = 400	Building costs are incurred only in first year.
DRB	*Durables*			
DR1	Furniture	EC dollars worth	P(DR1/SC1) = 1 000	Furniture requirements diminish after first year.
			P(DR1/SC2) = 450	
			P(DR1/SC3) = 450	

continued overleaf

TABLE 4. Continued

Code name	Name of input	Units of measure	Policies defining activity	Remarks
			P(DR1/SC4) = 450	
DR2	Equipment	EC dollars worth	P(DR2/SC1) = 550	Equipment input only in first year.
DR3	Books	EC dollars worth	P(DR2/SCL) = 500	Constant input of EC$ 500 per year per school.
CSB	*Consumable supplies*	EC dollars worth	P(CSB/PPL) = 0.62	Sixty-two cents consumable supplies per teamed pupil, based on pilot school experience, where CSB were requisitioned by each school on basis of need.

(ST3) is provided per teamed school, thus providing more concentration of this resource in the first year of teaming than in subsequent years.

Training of school staff is provided by spring workshops (WK1) of one-week duration and summer workshops (WK2) of two weeks. This is the only means anticipated for providing training in team teaching, and in curriculum development related to team teaching. Provision of one foreign consultant (CN2, CN3) per workshop has been assumed. No other consultants from overseas are anticipated, this work being done by local consultants (CN1). Other local experts might well also prove valuable to the activity as a whole but are not considered in this model. Attendance at workshops is taken as 100.

Costs of building modifications (BDG), durable equipment (DRB), and consumable supplies (CSB) are included, based on past experience. Expenditures on these items are higher in the first year than in subsequent years. No further breakdown of these items is included, thus allowing for flexibility of action in individual cases, either through local or ministry initiative. Units for these inputs are given as 'dollars worth'.

2. *Some comments*

A few comments are included here as clarification and reminder of the nature of this example.

The analysis here relates not to the operation of the educational system, or even to the total operation of certain schools within it. Our attention is directed to only a part of the operation of certain schools.

When the costs of a *change* are considered, only those arising because of that change should be included. The marginal cost of the change, and only the change, should be determined. Once it is possible to isolate marginal costs, it is possible to compute the effects of particular policy decisions. In the present case, for example, the direct cost of teachers was not included, since no additional expense for teachers' salaries was experienced. Additional costs for teacher aides, special training of teachers and teaching supplies were, however, included.

Projections of this kind can also be made for the entire system if needs be. The point is simply that such total scope is often not necessary in making and carrying out individual operational decisions.

The structure of this model reflects the nature and availability of the information needed to apply it. Data on educational policies and costs for the BTTP came from conventional sources: published documents, both of the Ministry of education and of the Project; examination of unpublished records; and interviews with participants. The primary problem was in obtaining a balanced and coherent collection of data compatible with the needs of the model. This ultimately involved using all available sources and in some instances a considerable amount of approximation.

Information directly related to the experience with team teaching was used when available. Other information from the schools in the pilot project was used as a next best choice. Failing these, national averages were relied upon. From

this practical experience, two lessons are clear to the technician in his role of service to the executive. First is the necessity for making extensive approximations for the sake of getting the job done. Second is the need to check, confirm and revise these approximations and their results.

Because of limitations of data and because of the need for making projections of cost quickly and inexpensively, certain technical refinements have not been included. In the first place, no changes of price structure or of exchange rates were taken into account because of uncertainty about their nature and the virtual impossibility of anticipating them. Their importance is somewnat diminished by the fact that uncertainties of the economic and financial future will tend to affect the expenditures of the government as a whole. Hence the projections given here are more stable if looked at in terms of their relation to total government expenses, rather than in pure monetary terms. Some kinds of changes, such as the income of teachers relative to other workers, will be important but can only be taken into account by frequent revision of plans and budgets.

Depreciation of facilities, discounting of future expenditures and subdivision of expenditure by type were also ignored. These might be added at a later time, though at some expense of effort and computation.

We consider that our experience with regard to data, accuracy and approximations was a typical one. We are by no means uncritical of any inadequacies we found in data availability.

3. *Implications of the example case*

Unit costs for the example, input quantities, costs of each input and their resultant costs are shown in Table 5. It will be recalled here that by 'resultant cost' is meant cost of the item itself plus cost of all those items whose existence derives from it. The resultant cost of the project as a whole is therefore the total cost of the team teaching activity for the first academic year of extension beyond the pilot stage.

It is interesting that the computation of costs can be, and is, carried out without reference to the 'teaming' part of team teaching. Teams are never specifically taken into account in the model except as a means to determine the number of pupils affected in the first year of teaming. Otherwise all inputs could be defined and exist independent of teaming. This implies two things. Firstly, that the organizational aspects of team teaching do not cost anything. Secondly, that the material and human outputs need not relate to teaming *per se*. This is consistent with the fact that many activities at present associated with team teaching, e.g. special field supervision and curriculum development workshops could, and probably eventually will, be taken into the general operation of the educational system.

4. *The need to compute changes in cost*

Estimates of cost of one year's additional operation, as given above, are informative, but decisions often require additional information about costs along the

TABLE 5. Unit, item and resultant costs of inputs for the example case (in EC$)

Input[1]	Q = quantity[2]	U = unit cost	C = item cost ($Q_a U_a$)	Resultant[3] cost
PRJ	1	4 000	4 000	83 573
SC1	5	—	—	31 025
SC2	—	—	—	—
SC3	5	—	—	18 300
SC4	—	—	—	—
TMS	25	—	—	—
PPL	3 950	—	—	2 449
WK1	1	800	800	7 260
WK2	1	400	400	3 980
SP1	1	10 065	10 065	13 003
SP2	1.33	8 738	11 651	13 609[4]
SP3	1.67	2 938	4 890	4 890
TN1	2 (trips)	600	1 200	1 200
TN2	12 (weeks)	400	4 800	4 800
CN1	240 (consult.-days)	17.50	4 200	4 200
CN2	2 (trips)	700	1 400	1 400
CN3	15 (consult.-days)	210	3 150	3 150
SS1	10	—	—	—
SS2	20	—	—	—
SS3	24	—	—	—
SS4	22	—	—	—
SS5	36	—	—	—
ST1	25	—	—	—
ST2	102	—	—	—
ST3	10	1 627	16 270	16 270
SW1	15 (person-days)	30	450	450
SW2	1 200 (partic.-days)	0.70	840	840
BDG	2 000 (dollars worth)	1	2 000	2 000
DR1	7 250 (dollars worth)	1	7 250	7 250
DR2	2 750 (dollars worth)	1	2 750	2 750
DR3	5 000 (dollars worth)	1	5 000	5 000
CSB	2 450 (dollars worth)	1	2 450	2 450

1. For definitions of inputs see Table 4.
2. Quantities refer only to the example case for the year 1969/70.
3. Whereas unit and item costs include only the direct cost of the input, resultant costs include also the cost of derived inputs.
4. Excludes costs of training (TN1 and TN2), since these bear a non-linear relationship to SP2. See appendix.

following lines: (a) a year by year programme of costs and expenditures; (b) comparison of the cost of the activity with that of other activities in the educational system; and (c) identification of alternative actions that are available at costs equal to one another. The key to the usefulness of this information is the ability to provide it cheaply and quickly. It is hence important to be able to compute readily the cost of changes in the example.

The means for doing this are already in the cost model we have been describing. It will be recalled from our earlier example that six mangoes were to be purchased at six cents each, and that their consumption implied the use of two paper napkins per mango, each napkin costing two cents each. If we wish to consider a change in numbers of inputs and decide to buy one fewer mango (and thus two fewer napkins), we save a total of ten cents (six cents for the mango, four cents for the napkins). So long as unit costs do not change, mangoes may thus be added to or deleted from our plans at a resultant cost of ten cents each. The best number to include will then be a matter of judgement and of the value attributed to other uses of the money.

A second type of decision is involved when one considers a *policy change* in the number of napkins supplied with each mango. If we start with six mangoes, the addition of one napkin per mango will cause a total additional cost of twelve cents to the activity as a whole. The worthwhileness of such a change must be judged on the basis of the messiness involved in using more or less napkins, as compared with the cost of the additional napkins. Note here also that a whole number of napkins per mango need not be specified, but that a fractional average number makes good conceptual sense.

The effect of *changes in unit cost* can also be computed. An increase of one cent per unit of mangoes will add six cents to the cost of the activity. A similar increase in unit cost of napkins creates a resultant change of twelve cents. Changes in unit cost do not bear directly on evaluation of the activity and the policies relating to it. They relate rather to the worthwhileness of peripheral efforts to bring cost down, through bulk buying, bargaining with mango producers, or by the purchase of a different kind of napkin.

Clearly other considerations become important here, such as the cost of making the changes, and the 'quality' of the activity after the changes have been made. Facility in estimating costs may clarify such issues but they must usually be resolved in other, usually subjective, terms.

5. *From the example case to an example programme*

In considering extension of the team teaching programme, the example described earlier (and summarized in Tables 4 and 5) has been extended through time, specifying the addition of five new teamed schools each year. In the first such year there would be five new schools, plus the five schools of the pilot Team Teaching Project. The number of teamed schools, pupils and field supervisors, for 1965 to 1978, is shown for this plan of expansion in Table 6.

Clearly, teamed schools can be introduced at any desired speed, based on decisions made year by year. It is unlikely, of course, that any school once teamed can be quickly de-teamed. In other words, the cost-consequences of present actions must be borne through the foreseeable future. Moreover, it seems that the gradual introduction of a specific innovation such as team teaching to the entire system may be a good way of upgrading the educational system bit by bit. Making improvements across the board would probably either

TABLE 6. An example programme for expansion of team teaching

Year	Total schools	SC1[1]	SC2[2]	SC3[3]	SC4[4]	Pupils teamed	Field supervisors[5]
1965/66	5	5	—	—	—	1 321[6]	1
1966/67	5	—	5	—	—	2 830	1
1967/68	5	—	—	5	—	3 270	1
1968/69	5	—	—	5	—	3 270[7]	.3
1969/70	10	5	—	5	—	3 950	1.3
1970/71	15	5	5	—	5	6 750	1.8
1971/72	20	5	5	5	5	10 000	2.1
1972/73	25	5	5	10	5	13 250	2.4
1973/74	30	5	5	15	5	16 500	2.8
1974/75	35	5	5	15	10	19 750	3.0
1975/76	40	5	5	15	15	23 000	3.3
1976/77	45	5	5	15	20	26 250	3.5[8]
1977/78	50	5	5	15	25	29 500	3.5

1. Schools in first year of teaming.
2. Schools in second year of teaming.
3. Schools in third to fifth years of teaming.
4. Schools in sixth and subsequent years of teaming.
5. For 1965-68 the Harvard resident consultant is used for this figure. In 1968/69 the Executive secretary is presumed to devote .3 of his time to field supervision.
6. This is an average of 765 first term and 1,967 second term.
7. Taken as equal to 1967/68 figure.
8. This is the maximum number of field supervisors under the example case used for these calculations

be too expensive or would entail such minor improvements as to be negligible. Whatever path of improvement Barbados might eventually follow, whether it includes team teaching or not, this plan of introduction by small groups of schools has much to recommend it.

This plan of expansion is based on an imaginary set of policies, which are nevertheless realistic. But the essential point is that alternative policies could easily and quickly be incorporated into a revised plan of expansion.

Table 7 traces the additional monetary cost of team teaching in Barbados from the introduction of the pilot Team Teaching Project in 1965 until 1978. The figures for 1965 to 1967 are historical costs of the pilot project. Those for 1968 represent the budget for that year. The figures for subsequent years are based on the example defined in Tables 4, 5 and 6. For 1968–70, the quantities given by functional category in Table 7 are shown in detail in Table 5. For subsequent years, Table 7 is derived from the quantities and policies set forth in Tables 4 and 6.

Of the seven functional categories, expenditures on two (Executive secretary and in-service training) are constant through the years because they depend solely on the existence of the Project. Two more (field supervisors and teachers' aides) depend on the number of schools teamed, as given in Table 6. Training in the United States is dependent upon the number of new field supervisors being taken on, and is therefore quite irregular through time. Buildings, etc., depend in a more complex way on the number of schools and the number of pupils. Finally, the figure for contingencies is set arbitrarily at EC$ 4,000 annually. The details

TABLE 7. Total cost of example programme by functional category and year (in EC$)

	Executive secretary	Field supervisors[1]	Training in USA	In-service training	Teacher aides	Buildings, equipment materials	Contingencies, miscellaneous	Total	Pupils teamed (by academic year)
Historical costs									
1965	6 830	24 950	14 700	5 650	1 370	9 450	250	63 200	1 321
1966	12 000	34 000	6 950	13 050	6 380	10 800	1 140	84 320	2 830
1967	10 300	34 200	8 690	4 620	7 900	4 640	4 850	75 200	3 270
1968 budget[2]	17 400	25 570	11 840	7 000	9 520	6 000	12 550[3]	89 880	3 270[4]
Example programme									
1969/70	13 000	13 610	6 000	11 240	16 270	19 450	4 000[5]	83 570	3 950
1970/71	13 000	17 860	—	11 240	24 405	25 935	4 000[5]	96 440	6 750
1971/72	13 000	21 260	3 000	11 240	32 540	32 700	4 000[5]	117 740	10 000
1972/73	13 000	24 660	—	11 240	40 675	39 465	4 000[5]	133 040	13 250
1973/74	13 000	28 060	—	11 240	48 810	46 230	4 000[5]	151 340	16 500
1974/75	13 000	30 610	—	11 240	56 945	52 995	4 000[5]	168 790	19 750
1975/76	13 000	33 160	3 000	11 240	65 080	59 760	4 000[5]	189 240	23 000
1976/77	13 000	35 710	—	11 240	73 215	66 525	4 000[5]	203 690	26 250
1977/78	13 000	37 810	—	11 240	81 350	73 290	4 000[5]	220 690	29 500

NOTE These are costs over and above regular Ministry operating expenditures. Costs for 1965-68 refer to calendar year; those for 1969 and beyond to academic year.

1. Resident consultant in 1965-68; field supervisors thereafter.
2. This is the revised 1968 budget of the Team Teaching Project, and it is not related to the example programme presented here.
3. This is a budgeted figure and therefore comparatively higher than actual past expenditures under this heading.
4. Estimate for academic year 1968/69.
5. Arbitrary sum for overhead and contingencies.

of these calculations are somewhat involved and would be out of place here. They all follow directly, however, from the specifications in Tables 4 and 6, and from the model for computing cost presented earlier.

A few implications of the proposed plan for continuation are summarized below (figures are in EC dollars).

1. If five new schools are teamed each year, about 60 per cent of primary-level pupils will be teamed by 1978 and all by about 1990. The number of teamed pupils would increase from about 3,300 in 1968 to about 30,000 in 1978.
2. Between 1968 and 1978, costs per pupil (i.e. the extra cost per pupil of using team teaching) will have been sharply reduced, from $27 to $7, due mainly to savings in overhead costs such as field supervision, overseas training and other 'starting-up' costs, which become proportionately less as larger numbers of schools are included.
3. Over time, there would be a decrease in the proportion of costs allocated to field supervision and training in the United States, from about 55 per cent to about 17 per cent. There would be a corresponding shift to materials and teacher aides (18 per cent in 1965–67, 70 per cent by 1978).
4. Costs per pupil teamed would drop from about $21 in 1969/70 to less than $8 in 1976/77.
5. Total operating costs of team teaching were approximately $90,000 in 1968, with five schools teamed. With fifty schools teamed by 1978, annual costs would then be about $220,000.

It is interesting to note the variability among historical figures as contrasted with the regularity of the projections. The historical figures display the variations that are characteristic of reality, often masking whatever regularity there might be underlying the long-run trends. The projections, however, represent not what really will happen, but the trends around which actual experience will fluctuate. They thus are a guess and a guideline for the future. The fluctuations about them cannot be predicted, though to some extent their magnitude might be estimated.

6. *Comparison with other costs of operation*

Comparison of the costs of team teaching with normal costs of operation is shown in Table 8, comparing total primary-level expenditure and per-pupil expenditure in teamed and unteamed schools. In the first case a very gradual percentage rise (less than half a per cent annually) covers the additional cost of teaming after the first year. The initial cost (1969/70) would be about two per cent of total expenditures on primary-level education. Since it is not possible to take into account future changes in prices, foreign exchange, educational policy or availability of personnel, the comparisons, therefore, cannot be taken fully at face value but rather as an estimated trend in terms of general magnitudes of expenditure.

TABLE 8. Comparison of team teaching costs with normal operating expenditure (in EC$)

Year	Pupils[1] teamed	Total cost[2] of example programme	Percentage of present primary-level[3] expenditure	Per-pupil cost of example programme	Per cent of present per-pupil[4] expenditure
1969/70	3 950	83 570	2.1	21.15	21.0
1970/71	6 750	96 440	2.4	14.20	14.1
1971/72	10 000	117 740	2.95	11.70	11.6
1972/73	13 250	133 040	3.35	10.05	9.95
1973/74	16 500	151 340	3.8	9.20	9.1
1974/75	19 750	168 790	4.25	8.55	8.45
1975/76	23 000	189 240	4.75	8.20	8.1
1976/77	26 250	203 690	5.1	7.75	7.65
1977/78	29 500	218 590	5.5	7.45	7.35

1. See Table 6 for details.
2. See Table 7 for breakdown by functional category.
3. 'Primary level' includes juniors and primary departments of all-age schools. The primary level-expenditure used here is based on the EC$ 101 per pupil given in note 4 below, times primary level enrolment. The resulting total is EC$ 3,975,000 per year.
4. Per-pupil expenditure is based on 1966/67 estimates of expenditure (recurrent and non-recurrent) for primary, comprehensive and all-age schools. Expenditures for capital and for general administration are not included. The result is EC$ 101 per pupil, based on data from the Barbados, *Digest of Educational Statistics 1966-67* (corrected version), Tables F-2, P-1.

7. *Comparison among alternative programmes*

There is another way in which inexpensive computation of the cost of programme changes is of possible use to decision-making. That is in the comparison of programme alternatives that could be carried out at equal or equivalent cost. The idea is to recognize a set of such equivalent programmes, so that a choice can be made among them. As an example, some pairs of equivalent modifications are shown in Table 9. These are partial and illustrative only and refer only to the first year of continuation of the team teaching activity. They are given to suggest possible uses for information on costs rather than to suggest particular proposals. Table 9 must not be taken to attribute to these comparisons a preference for any particular type of input. That is a question not for cost analysis, but for the other, more subjective, side of the evaluation process.

It should be emphasized that personnel, particularly trained personnel in the schools, are the key factor in improving the quality of instruction. Under any circumstances, but particularly given their short supply (as is the case in Barbados), their efficient utilization is of utmost importance. It is important to design the environment in which they work in such a way as to make the best use of their skills. This environment can be considered in three parts: (1) Human—the persons with whom the head teachers and trained teachers work and whose work supports and amplifies the effect of their efforts; (2) Physical—including the buildings, equipment, materials, books and supplies that aid the teachers' work; and (3) Organizational—in terms both of method and of administration, providing the continuity of structure within which teachers work. Human,

TABLE 9. Some example alternatives at equal cost (approximate figures for first year of operation of the Example Programme)

A one-week workshop is roughly equivalent in cost to:	
	Reduction of supervision load from five to four new schools per supervisor;
or	$400 in equipment and supplies for each of ten schools;
or	one additional trained teacher (year's salary) for the Project as a whole.
One week's visit by an overseas consultant is roughly equivalent in cost to:	
	An additional teacher aide for the project as a whole;
or	$175 additional in equipment and supplies for each of ten schools;
or	an additional $0.45 per pupil for materials.
For each 1,000 pupils, to replace one trained teacher by one acting teacher is roughly equivalent in cost to:	
	Five additional teacher aides for the project;
or	$850 additional in equipment and supplies for each of ten schools;
or	two additional one-week workshops;
or	three six-week training trips to the United States;
or	some combination of the above.
One six-week training trip to the United States is roughly equivalent in cost to:	
	Reduction of supervision load from five to slightly more than four new schools per field supervisor;
or	two additional teacher aides for the project;
or	$300 in equipment and supplies for each of ten schools;
or	one eleven-day visit by an overseas consultant.

NOTE The above are examples only, to give an idea of the alternatives available at equal cost. Choice among them (or others) is a matter for decision based on cost figures in conjunction with other forms of evaluation.

physical and organizational inputs should be provided in a balanced mix. The equivalencies suggested by Table 9 illustrate one simple tool for comparing alternative combinations of inputs which contribute to finding the combination that provides most benefit within available resources.

V. Past and potential uses of cost projections

The analysis of costs described here was carried out without attempting to measure the benefits arising from the objects of those costs. Measurement of the Project's benefits is an integral part of the design of the BTTP, both through qualitative measures and objective tests. These are outside the scope of this paper, and as yet incomplete.

In fact, there are certain advantages to carrying out cost projections without direct reference to the results they imply. If the method of projecting cost is flexibly and cheaply enough done, it can serve well by repeatedly and quickly answering questions of the form 'What would be the likely consequences in terms of cost if we did this instead of that?' It is a tool of this kind we are aiming at here.

A second advantage of projecting costs independently is that this projection then need not wait for the results of other kinds of evaluation. In presenting this analysis we were careful to avoid expressing value judgements, but it is inevitable that such judgements creep in. In the first place, the very selection of some components for emphasis over others indicates judgements of value. Secondly, in carrying out detailed work, certain conclusions inevitably emerged.

In the introduction of team teaching to a set of pilot schools, certain expenditures appear to have had more impact than others, when viewed with respect to their cost. Those that particularly caught our attention are:

1. The appointment of one particularly able teacher as a 'reading consultant'. This has included providing her with specialized training during a six-week course in the United States and then releasing her part of the time to visit the several schools of the pilot project for the purpose of observing and giving advice upon instruction in reading. This has the advantage of developing local personnel, both through training of this reading consultant and in using her skills as a stimulus to the improvement of other teachers.
2. The hiring of a 'teacher aide' for each of the pilot schools. These aides are paid a fraction of the salary of a trained teacher and release trained and experienced staff from routine and mechanical duties. The results appear to be an improvement in effectiveness and morale of the teaching staff.
3. In-service training, in the form of workshops held for teachers twice a year. These at first involved teachers from the pilot schools of the Team Teaching Project, but now seem well established as a means of giving additional training to a more general group of Barbadian teachers. The workshops provide: direct training; experience in supervision and curriculum design for those who plan and operate the workshops; and intercommunication of ideas among the participants.

The above are some of the 'best buys' identified through experience in the BTTP and subsequent analysis of its costs. The analysis used in picking out these activities for emphasis is admittedly incomplete. It justifies itself in that evaluation at all degrees of completeness is useful. It is important, of course, that preliminary judgements such as these be supported through fuller analysis when and as possible.

Extension beyond team teaching

The results of the cost projections in this paper as they were devised for use with the Barbados Team Teaching Project and their possible use have been shared with the personnel of the project and with officials of the Barbadian Ministry o

education. It is, however, too early to know the type or extent of their effect.

Interest was expressed in the potential of methods of this kind as an aid to planning, decision and action in operations beyond that of the team teaching application. The following summarizes our conception of this potential.

If costs are to serve a useful role in aiding executive action in planning, decision and implementation, the information they provide must be *relevant* to that action; suitably *accurate;* and *economical* of use.

Relevance is a matter that relates to individual cases and can hardly be discussed in a general way. Suffice it to say that whenever the use of cost projections, by these or other means, offers better results, this criterion is satisfied.

The second criterion, *accuracy*, is again closely related to individual cases. The model as developed so far depends on the activity being made up of simple and clearly defined parts and on simple relationships among those parts. Extensions beyond these limits are technically possible. The nature and cost of these extensions, have not been investigated in detail, though it seems certain that some such extensions would be worth the effort.

With regard to the *economy* of using the model proposed here, we can speak only from the limited experience of the team teaching example. Once the model had been devised and the activity defined, the computation of the first year's projections required about two hours using an adding machine and slide rule. Another two hours served to extend the projections to 1978. The expenditures in time to make calculations of this sort are thus not great. A skilled clerk would be capable of doing this work and it would take about two weeks to train him.

Appropriate definition of the programme to be costed is another matter. It requires considerable care and time to identify the different components of activity and specify the linkages between them that correspond to policy statements. It is not possible to estimate the time needed for such an effort, since it would vary greatly from case to case. The time expended in this work is likely to be measured in days and it should involve at least one person with considerable knowledge and experience of the programme to be costed. This investment of time is more justifiable if the resulting description of the programme is to receive considerable use.

The criterion of economy of use is the one in which we are least convinced of success. There is a tendency on the part of administrators to leave computations of this sort to technicians. This is appropriate so long as communication between the two is sufficient for the administrator to make full use of the technician. The advantage of the model proposed here is that the technical principles are not very esoteric and the policy relationships are made very explicit. Consequently, the implications of policy alternatives are very quickly accessible to administrators who are willing to utilize the technician's skills for this purpose.

VI. Final comments and summary

The intention throughout this paper has been to show how analysis and projection of costs can aid educational planning and decision-making. We have suggested various ways in which such a cost analysis can be employed, particularly in projecting the marginal costs of a well defined activity added to normal operation. Some practical guidelines for such activities have been presented as well, along with examples of their application. Although these comments are made with relation to a particular programme, they are intended to be valid over a range of contexts. Throughout, we have tried to show how information about cost can be used as an integral tool for planning, as an aid to decision and as a prerequisite to implementation.

The remarks which follow are addressed not so much to the technical substance but to the uses of cost projections and the steps which are needed to put the technical steps into use.

Costs are considered here in the context of a 'planning-implementation' process, which includes planning, decision, implementation and confirmation of results.

Costs are a natural part of the description of most activities. They provide one way to test the feasibility of a plan and to provide confirmation of whether intentions have been carried out. Also, information about costs can be of use in evaluation of choices among alternative courses of action.

Many decisions and many costs are best conceived as marginal, that is, as adjustments to an already existing situation.

Any projection of the costs for a real situation will involve approximations. Care must be taken that these lie within acceptable bounds. In general they must be compatible with the required accuracy of the ultimate results and with the accuracy of the other contributors to those results.

Within the limitations implied above, the steps needed to prepare an estimate of the costs of an activity are:

1. Identify the activity for which costs are to be determined, being specific as to what is and is not included in it.
2. Identify the measurable components which are included in or implied by the activity, taking care to state clearly the units in which they are to be measured.
3. Identify the relationships ('policies') that obtain among the quantities of items included in the activity.
4. Confirm that this structure of quantities and policies is an adequate representation of the activity for intended purposes; and the range of conditions for which this representation holds.
5. Determine the unit costs of the individual things that make up the activity.
6. Compute the costs of the individual parts of the activity and of the activity as a whole.
7. Confirm that these results are reasonable and acceptable. Otherwise discard or adjust them.
8. Compute variations as needed to compare alternatives; extend the projections through time; and otherwise produce information useful to making decisions.

The present analysis and projection of costs was intentionally carried out without attempting to measure the benefits arising from the objects of those costs. Projection of costs unattached to explicit measurement of results has the advantages that it can then be treated as a separate tool and that its use with other components of decision can come at a later stage.

If costs are to serve a useful role in aiding executive action in planning, decision and implementation, the information they provide must be relevant to that action, must be suitably accurate, inexpensive in relation to its worth and sufficiently easy to use, and interpretation must be accessible to those who make and carry out decisions.

If the tool is to be of general use it must relate not just to one specific situation but be adaptable for a considerable range of circumstances. It has been our intention to develop, describe and illustrate the projection of costs with that in mind.

Appendix

Technical description of the model

A somewhat more concentrated technical description of the model developed in the earlier part of the paper is now given.

The quantities to which costs are related will be represented by the letter Q. The name of the item being quantified will sometimes be identified by a three-letter abbreviation suggestive of its name, as SCL for school and PPL for pupils. When more than one type of an item is being considered, the last letter of the abbreviation is replaced by a number, so that SCL represents schools in general and SC1 and SC2 represent two different types of schools. A number of pupils can thus be represented as Q (PPL), for example, and numbers of schools as Q (SC1) and Q (SC2). Care must be taken to make these abbreviations unique so that they completely and unambiguously represent the quantities that are of interest. Table 4 lists the quantities and codes that have been used in estimating and projecting the costs of team teaching.

For the purposes of abstract discussion, it will sometimes be useful to identify quantities by subscripts, so we will occasionally speak of Q_a, Q_b, etc., to mean quantities of different things. In each case the intention should be clear from the context.

Quantities of inputs will be related to one another by coefficients or 'policies', denoted by the letter P. These 'policy' coefficients define linear relationships among quantities. They can reflect either administratively-determined policies or conditions existing in the school system, such as teacher/pupil ratios. The coefficients relating teachers to pupils would be represented by P(SSC/PPL), where SSC is the code for school staff. Numbers of teachers would be derived as follows: Q(SSC) = P(SSC/PPL) Q(PPL), e.g. 18 teachers = 0.3 teachers per student × 600 students.

For discussion in the abstract we will often represent a policy relating input *b* to input *a* by P_{ab}. Then we will write: $Q_b = P_{ab}\, Q_a$.

A quantity may be derived from more than one source. For example, school staff may be required not only for teaching (in relation to the number of pupils), but also for administration (in relation to the number of schools). In this case, if we are deriving *b*s from both *a*s and *c*s, we have $Q_b = P_{ab}\, Q_a + P_{cb}\, Q_c$. If we want to denote only those *b*s derived from *a*s, we write $Q_{(a)b}$.

A complete set of policy coefficients is in effect the definition of the activity under consideration. The set of all policies P_{ab} converts a prescribed set of independent inputs to a complete list of the quantities of all the inputs to the activity. The mechanics of computing the consequences of this definition can be described in terms of matrices, or in terms of a 'tree', which branches from input to input, so long as the existence of any input implies yet another. The *matrix* approach is a better way to deal with large numbers of inputs and policies, and particularly for automatic computation. On the other hand, the *tree* provides a clearer visual representation and helps to ensure that the description is complete, consistent and not redundant in terms of derived inputs. It is better suited to a relatively simple situation like the Barbados Team Teaching Project and will be used in the description and examples given below.

Inputs and corresponding policy coefficients can be aggregated or disaggregated according to the nature of the activity, the information and time available and the detail required.

Once a full set of input quantities has been identified, the resulting costs can in general be computed quite readily. This requires having in hand a set of unit costs, one for each of the anticipated inputs. These unit costs will be denoted here by U_a, or, for example, by U(SS1). Only the direct cost of the input itself being considered is included in U_a. Not included are the costs of other inputs deriving from it. In other words, we are talking about the cost of mangoes without including the cost of napkins,

Clearly, correct definition of unit costs can be tricky. Some inputs have zero unit costs, as for example U(PPL) = 0. Other inputs, like consumables, often cannot be dealt with in detail. Their units can be defined in aggregate terms as 'dollars worths' (as was indeed done in practice in the original budgets of the Team Teaching Project).

The unit cost (U_a) of an input times its quantity (Q_a) gives what we refer to as the *item cost* C_a for that input. Item costs can be combined to give a projection of cost by year and by object of expenditure.

Computation of variations in cost

Cost variations can be computed on the basis of changes in P_{ab}, Q_a and U_a. The effect of changes will be computed with the aid of a new quantity, *resultant cost*, which includes not only the direct cost of a given item but also the costs of items implied by it. As before, we can distinguish *unit* resultant costs and *item* resultant costs. The resultant cost of the *item* 'mangoes' includes the cost of six mangoes and twelve napkins. The *unit* resultant cost is the cost of *one* mango and two napkins, assuming a policy of two napkins per mango.

Table 5 gives a list of inputs, showing unit and item costs and resultant costs for the example discussed in the body of the paper. Resultant unit and item costs can be defined more formally as follows:

Item resultant cost T_a is the item cost of the quantity Q_a plus the item costs of all those quantities deriving from Q_a. Thus $T_a = C_a + \sum_b T_{(a)b}$ where the summation is taken over all those inputs which derive in the tree directly from Q_a. These in turn may imply other inputs, but the definition of $T_{(a)b}$ is such as to take that into account. For inputs at the extremities of the tree, i.e. at the tips of the smallest branches, the item resultant costs are identical with the item costs, that is $T_c = C_c = Q_c U_c$, where Q_c is an input quantity from which no further inputs are derived. Unit resultant cost, R_a, is analogous to T_a, except that it refers to *unit* costs (e.g. the total direct and indirect costs of a *single* workshop) as opposed to *item* costs (e.g. the total annual cost of *all* workshops). *Unit* resultant cost, R_a, is therefore equal to the *item* cost T_a divided by Q_a. Thus we have $T_a = Q_a R_a = Q_a U_a + \sum_b Q_{(a)b} R_{(a)b}$. Hence (dividing throughout by Q) $R_a = U_a + \sum_b P_{ab} R_{(a)b}$. It should be noted that P_{ab} is, by definition, $Q_{(a)b} Q_a$.

It is clear in the above that each branch of the tree must be accounted for separately and that no aggregation of like inputs should be made while resultant costs are being computed.

Once the unit resultant costs associated with each input quantity are computed, the effect of changes in policies or in unit costs can be computed by considering those branches affected by the change. The mechanics of computing these changes in cost differs according to whether one or more than one change in governing conditions is being considered.

When the change in cost is the result of only one change in the situation giving rise to it, the change (ΔT_a) in item resultant cost will take one of the following forms:

1. As the result of a *change* ΔU_a *in unit cost:*

$$\Delta T_a = Q_a \, \Delta U_a$$

e.g. if we buy six mangoes ($Q_a = 6$), and they increase in price one cent each ($\Delta U_a = 1$), then $\Delta T_a = 6$ cents.

2. As the result of a *change* ΔQ_a *in quantity of the item to which* T_a *relates:*

$$\Delta T_a = R_a \, \Delta Q_a = U_a \, \Delta Q_a + \Delta Q_a \sum_b P_{ab} R_{(a)b}$$

e.g. if we buy nine mangoes instead of six ($\Delta Q = 3$) and each mango requires two napkins (input b) at two cents each, then $\Delta T_a = 30$ cents, including the cost of both extra mangoes ($U_a \, \Delta Q_a = 6 \times 3$) and extra napkins ($\Delta Q_a P_{ab} \, R_{(a)b} = 3 \times 2 \times 2$).

3. As the result of a *change* ΔP_{ab} *in a policy* which arises from the item:

$$\Delta T_a = Q_a R_{(a)b} \, \Delta P_{ab}$$

e.g. if we decide to have only one napkin per mango ($\Delta P_{ab} = -1$) instead of two, we have $\Delta T_a = -12$ cents (plus messy hands, which is a subjective output that cannot be measured quantitatively).

4. As the result of a *change* $\Delta R_{(a)b}$ *in the unit resultant cost* of an item deriving from the given item:

$$\Delta T_a = Q_a P_{ab} \, \Delta R_{(a)b}$$

e.g. if the resultant cost of napkins goes up from two to four cents ($\Delta R_{(a)b} = 2$) then $\Delta T_a = 24$ cents. Hence the change in total cost can readily be computed in each of the above cases. Unit resultant costs are a convenient tool here. They need be computed only once, and can thenceforth serve in the evaluation of any change.

When more than one change in policy, quantity, or unit cost is to be considered, the mechanics of computation become somewhat more involved. There are many ways to do such computations, all equally valid so long as they account for each change once and only once. The method given below is one that is defined clearly in terms of the model developed here.

Given that a set of changes in policy, quantity, or unit cost are to be assessed in terms of their effect on total cost, all inputs which are affected by these changes must be taken into account. This can be done by identifying all inputs that are directly affected by the changes and all those which lie between them. Then, starting with those nearest the 'tips' of the branches of the tree, changes ΔR in unit resultant cost are computed at intervening points until the affected input closest to the 'trunk' is reached. At this point the change ΔT in item resultant cost is computed. This is the total change in cost which is sought. This process allows all changes in cost to filter down and affect the final change ΔT.

Thus unambiguous formulae for computing changes ΔR and ΔT are needed. These are given below. Since

$$(1) \qquad T_a + \Delta T_a = (Q_a + \Delta Q_a)(R_a + \Delta R_a)$$

it follows that

$$(2) \qquad \Delta T_a = (Q_a + \Delta Q_a) \, \Delta R_a + R_a \Delta Q_a.$$

Similarly, since

$$(3) \qquad R_a + \Delta R_a = (U_a + \Delta U_a) + \sum_b (P_{ab} + \Delta P_{ab})(R_{(a)b} + \Delta R_{(a)b})$$

it follows that

$$(4) \qquad \Delta R_a = \Delta U_a + \sum_b P_{ab} \, \Delta R_{(a)b} + \sum_b R_{(a)b} \, \Delta P_{ab} + \sum_b \Delta P_{ab} \, \Delta R_{(a)b}.$$

An all-purpose equation can thus be obtained by substituting (4) into (2) as follows:

$$(5)\quad \Delta T_a = (Q_a + \Delta Q_a)\,[\Delta U_a + \sum_b P_{ab}\,\Delta R_{(a)b} + \sum_b R_{(a)b}\,\Delta P_{ab} + \sum_b \Delta P_{ab}\,\Delta R_{(a)b}] +$$

$$[U_a + \sum_b P_{ab}\,R_{(a)b}]\,\Delta Q_a.$$

These equations look complicated, but in most practical cases all but one of the component changes ΔU_a, ΔP_{ab}, $\Delta R_{(a)b}$ and ΔQ_a will be zero. The above expressions will thereby simplify considerably in practice.

The effects of changes are thus propagated through the tree by means of the changes ΔR, so that the above formulae applied the proper number of times in the appropriate places will do the job. The rest is accountancy.

Treatment of non-linearities

In the body of this paper we dealt with procedures for computing the inputs to an educational activity and their resulting costs. In that discussion it was assumed that the relationships between the several inputs to the activity were linear. These relationships were described in terms of 'policy coefficients' or 'policies'.

The property of linearity is of considerable convenience in computing changes in cost or in maximizing an objective function subject to constraints. For simply computing quantities of inputs and levels of cost in individual cases, however, non-linearities can be introduced with relative ease. This can be done in three ways.

Firstly, we can aggregate or disaggregate costs of input 'packages' according to where we wish to focus attention. The important thing about disaggregation is that it permits us to introduce *different* policy coefficients to input packages that are similar but are used under different circumstances. For example, inputs like schools, workshops and consultants have been disaggregated in our example case into more expensive and less expensive types (e.g. newly teamed schools require more supervision than experienced schools; local consultants cost less than foreign ones). A shift to cheaper types of inputs over time will result in a change in the average value of policy coefficients from year to year. The structure of the policy tree would remain the same, but the cheaper elements would gradually become a higher proportion of the total. Such shifts may reflect a 'natural' process such as the accumulation of skills in the schools, or they may reflect a definite policy, such as the replacement of foreign with local staff. The shift may be predictable and systematically built into a long-range programme, or it may be written into each year's programme as a result of *ad hoc* decisions.

A second way of treating non-linearities is illustrated by the handling of field supervisors in our example. The policy was defined as follows: one field supervisor per twenty schools *up to the level of one full supervisor* and one and only one such supervisor subsequently. Here the *dependence changes* from number of schools (SC4) to number of projects (PRJ), so that the policy is represented as:

$$\begin{aligned} P(SP2/^*) &= P(SP2/SC4) = .05,\ Q(SC4) \leqslant 20 \\ &= P(SP/PRJ) = 1,\quad Q(SC4) > 20 \end{aligned}$$

where the asterisk implies a change in the structure of the model. In the example programme (Table 6) this happens in 1977. The relationships defining the programme are linear except at the point Q(SC4) = 20. At this point another linear relationship is substituted, subject as always to future policy revisions.

A third form of non-linearity found in the example is that arising from 'lumpiness' in inputs. In particular, it was specified that each new field supervisor would receive a

period of training overseas. But field supervisors are added only occasionally as the programme expands, or as already trained supervisors leave. In the projections, only the former instance could be included, the latter not being predictable. In making calculations, care must be taken to identify points where a new field supervisor is introduced so that the cost of overseas training can be included. In computing changes in cost, special care must be taken that changes, if any, in the cost of overseas training are accounted for. This is not done automatically by the procedures outlined earlier, which apply only for conditions where the relationships among inputs are linear.

The above cases suggest a general approach to treatment of variable policy coefficients. For ranges of values of inputs where all relationships are linear, the methods already described are valid. Where linearity does not hold, costs themselves can be computed as long as the relationships among inputs are known, but *changes* in cost cannot be computed according to the formulae given in this paper. A full re-computation of cost is needed for each set of conditions.

If non-linearities can be restricted to a small number of instances, and the policies expressed in linear form elsewhere (i.e. if *piecewise linear* approximations to policies are acceptable), the methods suggested earlier will hold true at all but an isolated number of points. Special care must then be taken only when passing from one area of linear relationships to another. This was done, in effect, in two examples discussed above. In the case of field supervisors a continuous piecewise linear function of two parts is used. In the case of training, the function is also piecewise linear, but discontinuous.

In general, by allowing both continuous and discontinuous piecewise linear functions a wide range of non-linear relationships can be approximated. The computational tricks required at points of discontinuity do not seem likely to pose insuperable problems.

It must be remembered, however, that whatever specific procedures of computation are used policy coefficients should be subject to constant review and revision over time. It is better to draw attention to lack of foreknowledge than to give the falsely comfortable picture that information is valid over a long period without further need for verification or intervention.

Poland 15

The role of cost analysis in planning a teacher-training programme

prepared by K. Podoski

This study was prepared by a group of experts and researchers from the Ecole Supérieure de Pédagogie of Gdansk, Poland, headed by Professor Kasimir Podoski, with the assistance of Jacques Hallak and Francis Chetcuti of the IIEP. Philip H. Coombs served as principal adviser to the study.

Introduction

A. The educational system

The structure of the educational system in Poland is as follows:

1. *Primary education.* This is compulsory from ages 7 to 14, and the enrolment rate is approximately 100 per cent.
2. *Secondary education.* This covers general, vocational and technical education and is organized in four main types of institutions: (1) high schools for general instruction (four years); (2) technical schools or high schools for vocational and professional training (four to five years); (3) vocational training schools (three years) leading to evening technical schools and high schools for professional training; (4) preparatory agricultural schools (two years) leading to agricultural schools (three years). The high schools for professional training played an important role in training teachers for primary schools, but they are now being phased out and after 1970 no more teachers will come out of this type of institution. The enrolment rate in all types of secondary institutions for the age group 14 to 17 years in 1967/68 was 81 per cent.
3. *Higher education.* Institutions of higher education include universities, polytechnics, medical and other schools, and teacher-training colleges. There is a strong emphasis on higher technical education, which accounts for one-third of the total higher-education enrolment. Students in mathematics and natural science subjects form 6.5 per cent of the total student enrolment. In 1964 there were 231,000 students enrolled in institutions of higher education.

The expansion of the Polish educational system has been particularly noticeable during the last ten years, and as a result of the increasing need for more teachers the authorities have been forced to recruit those who would normally not reach the minimum accepted standard. Current expenditure on education increased from 8,100 million zloty in 1955 to 25,200 million zloty in 1967.[1] Capital costs amounted to over 4,200 million zloty in 1967 (at 1961 prices). Primary education accounted for 35 per cent of total current expenditure in 1967, secondary education for 36 per cent, higher education for 17.4 per cent, and maintenance of buildings for 11.6 per cent of the total. In 1955, 4.5 per cent of the net national product was spent on education, and in 1967 this figure had increased to 5.5 per cent. Private education plays a very minor role in the Polish education system.

B. Teacher training

After the Second World War, and up to 1955, the training of primary-school teachers was the concern of the teacher-training schools at the secondary-school level. The intake was from primary-school graduates and these were given a five-

1. 1969, 24 zloty = $1 US.

year course leading to a diploma equivalent to the French *baccalauréat* (total of eight plus five years of education).

From 1954 onwards, in order to upgrade the level of qualification of the teaching force and to accelerate their production, new teacher-training schools of two years' duration called *studiów nauczycielskich* (SN) were introduced. These schools recruited students who had completed four years of secondary general education in secondary schools. Graduates from the SN schools thus had a total of fourteen years of training (eight plus four plus two). This means that primary-school teachers at this time were trained either in the teacher-training schools or through the SN schools. Those trained in the teacher-training schools were later considered as not being sufficiently qualified to teach in the new eight-year compulsory system, and in 1965 recruitment in these schools was discontinued; therefore the last group of teachers trained in these schools qualified in 1970. The number of teachers trained under this system who are upgraded to the SN schools through evening courses or special seminars (in summer and winter sessions) is increasing considerably.

Secondary-school teachers are trained either in universities or in teacher-training colleges—*wyższe szkoly pedagogiczne* (WSP)—for five years after completing general secondary education. From 1952/53 until 1967, 13,500 teachers graduated from the universities while the WSP colleges produced 9,500 teachers. In addition, the WSP colleges organized upgrading courses for teachers; about 5,000 teachers have been upgraded in this way through evening or special courses. For further details of the output of all teacher-training institutions see the appendix.

C. Focus of the case study

By 1966 it had become increasingly evident that in order to improve both the efficiency and the quality of primary education in Poland it would be necessary to raise the level of professional training of the primary-school teachers. It was agreed that a formula of training must be found which would give the teachers a higher minimum level of education. Some members of the Educational planning board suggested that teachers should be trained through universities (four or five years after secondary education); others suggested the creation of a new type of teacher-training college, the *wyższych szkol nauczycielskich* (WSN), where the course would last three years after secondary. The choice of one or the other formula had obviously to be related to pedagogical, political, economic, etc., factors.

In 1967 and 1968 several groups of experts studied the various aspects of improving the level of qualification of the teaching force in Poland. A study was made of the cost of the existing teacher-training system and the cost of introducing an improved system which by producing more and/or better qualified teachers would raise the quality of elementary education. Essentially the alternatives were (i) improving the quality of the teachers already in service; (ii) improving the quality of new teachers; (iii) a combination of (i) and (ii).

The purpose of this paper is to summarize the results of this study and to analyse the different patterns of teacher training presented to the government.

I. Cost analysis of the present teacher-training system

A. Definition

The concept of 'institution cost' has been used. This covers the following: (a) expenditure financed by the schools' budget; (b) expenditure financed by the youth health service budget; e.g. medical and health services, dental service; (c) costs subsidized by grants received from parents' associations and direct costs supported by families, such as the purchase of books, sports clothes, overalls, transportation to and from school; (d) other costs supported by various gifts and grants.

Consequently, 'institution costs' cover a much wider range of expenditures than 'tuition costs'. This means that, in principle, the institution cost is greater than the sum of current and capital costs borne by the national budget. It does not include, however, the cost for amortization of land or the cost of general administration and of common services, which ideally would both be included in the total cost of education. The breakdown of institution costs which has been used in this study is the following: (a) salary cost; (b) maintenance of the school; (c) stationery and equipment; (d) building cost; (e) social costs: this item would not normally be included, but social costs play a determinant role in the planning of the Polish teacher-training system, therefore no comparison between various alternatives would be complete without reference to them. For example, there would be no significance in comparing evening courses with day courses without taking into consideration costs of transportation, grants, student aid and various other expenditures likely to be involved.

Another item included in this study was the extra cost of upgrading teachers from primary to secondary schools. The cost of replacing teachers who are absent from the school system during their upgrading course was also included. This factor demonstrates the necessity of including social costs when estimating the total cost of various teacher-training systems.[1]

1. Though capital expenditure for building was included in the concept of 'institution cost', the analysis is mainly concerned with recurrent unit costs, with no reference to capital costs. Equipment cost, however, has been included; it has been amortized over a period of ten years and the amortization cost included in the total recurrent cost. These costs were estimated over the period 1961-65. (IIEP)

B. Framework

In addition to the estimation of per-pupil unit cost, we have tried to calculate per-graduate unit cost after taking into consideration repetition and wastage.

Cost per graduate was equal to the per-pupil cost multiplied by the average duration (as opposed to the official duration) of the training course. This means that no differentiation has been introduced as to the level of per-pupil unit cost in the various grades of the teacher-training course.

Two categories of wastage have been distinguished: (i) the usual concept of wastage refers to those students who enter a teacher-training course and drop out before qualifying. This has been taken into consideration in the calculation of cost per graduate; (ii) another source of wastage is the students who actually qualify as teachers but choose some other form of work after leaving college. This is more often included in the concept 'teacher wastage' rather than 'wastage in the teacher-training course'. We have not included the cost of this wastage in the estimation of the cost of alternative teacher-training programmes, for two reasons: (a) we consider that the qualified teacher who does not enter the teaching force does in fact satisfy the manpower needs of the country in another sector of the economy; (b) in comparing the cost of alternative teacher-training systems there is no need to include the cost of teacher wastage unless the wastage rate differs from one system to another.

Salary costs

This is by far the most important component of institution costs. For the sake of simplicity, all the cost estimates have been based on the average salaries of teachers at the WSP teacher-training colleges; in fact, the average salary per teacher does not differ significantly from one teacher-training institution to another. For example, the average monthly salary of a teacher in SN schools and in higher education institutions as a whole is given in the following table.

TABLE 1. Average monthly salaries of teachers (in zloty)

Year	SN schools	All higher education institutions
1965	2 999	3 202
1966	3 374	3 327
1967	3 379	3 385

SOURCE *Statistical Yearbook, 1968*, pp. 421-422. Warsaw, Central Office of Statistics.

The number of teachers in the WSP colleges increased from 700 in 1965 to 1,000 in 1967. In the other teacher-training institutions teaching staff totalled 4,300 in 1967. It is not foreseen that the teacher/student ratios in these institutions will change significantly.

In 1968, there were seven systems of teacher training in operation:

1. Teacher-training schools for nursery and primary teachers (five years secondary level);
2. Day courses in the SN schools for nursery and primary teachers (four years of secondary general education plus two years training);
3. Evening courses in the SN schools for upgrading nursery and primary teachers (previous training in the teacher-training schools);
4. Special courses in the SN schools for upgrading nursery and primary teachers (previous training in the teacher-training schools);
5. Day courses in the universities or the WSP colleges for secondary school teachers (four years secondary general education plus five years training);
6. Evening courses in the WSP colleges for upgrading teachers (previous training in the SN schools);
7. Special courses in the WSP colleges for upgrading teachers (previous training in the SN schools).

As from 1968, following the advice of the Educational planning board, an eighth system was set up. This was a new type of teacher-training college (the WSN) adapted from the existing SN schools. Teachers graduating from these colleges would have four years of secondary education plus three years of teacher training.

C. Cost of training primary-school teachers

The average annual per-pupil cost in the teacher-training schools, the shortest method of training, is about 7,000 zloty. The cost per graduate for a course lasting on average 5.22 years is about 36,500 zloty. This cost and the average number of years take into account repetition and drop-out.

In all other systems of teacher training, students are enrolled after having completed four years of secondary education. It is therefore necessary to include the cost per secondary school graduate in the estimation of other teacher-training costs in order to have a consistent comparison. The average annual per-pupil secondary school cost was estimated at 2,700 zloty; the rate of wastage is very high. The average duration of a secondary general course is four to five years, which means that the per-graduate unit cost reaches 12,000 zloty. This amount should be added when estimating the cost of all types of teacher-training in Poland.

The per-pupil cost per year in SN schools amounts to 14,000 zloty, whereas the per-graduate unit cost was found to be as high as 35,000 zloty over the period 1961-65. Bearing in mind the theoretical duration of the course in the SN schools of only two years, the cost of wastage for each graduate is 7,000 zloty.[1]

In addition to day students, the SN schools recruit students for evening courses and special courses for in-service teachers who have graduated from the teacher-training schools.

1. $35{,}000 - (14{,}000 \times 2) = 7{,}000$ zloty.

The per-pupil unit cost per year for an evening course in the SN schools is 3,500 zloty and the cost per graduate is about 8,000 zloty. This means that the total cost of teachers qualified through teacher-training school and upgraded through an evening course is 44,500 zloty.

The cost of special courses has been estimated as being the same as the cost of evening courses, but one should add an extra transport cost for those students following the special course who have to pay for their travel between the schools where they teach and the SN; the extra cost per student has been estimated to be 1,500 zloty per graduate.

No replacement cost has been added to take into consideration the absence of teachers attending upgrading courses, the assumption being that (i) the teachers following these courses are not replaced and (ii) they are expected to respect the legal number of teaching hours required from all primary-school teachers, the upgrading course being considered as an additional effort over and above the normal teaching obligation.

D. Cost of training secondary-school teachers[1]

The normal way of training secondary-school teachers is through the universities or WSP colleges (four years of secondary general education plus five years of training).

On the basis of detailed cost studies it appears that the annual per-student unit cost for day courses is around 20,000 zloty and the per-graduate unit cost reaches 120,000 zloty, allowing for the high rate of wastage and repetition.

In the case of evening courses, the annual per-student unit cost amounted to 4,600 zloty over the period 1961-65, of which 4,100 zloty was provided by the training institution and 500 zloty by the schools where the students are in service. The latter amount is the extra cost for replacing teachers on study leave. The per-graduate unit cost is extremely high; 30,000 zloty, which is due to the fact that there is a high rate of repetition and drop-out. Therefore, the total cost for a secondary-school teacher who has been upgraded through an evening course in a higher education establishment is approximately 77,000 zloty.[2]

As more special courses to upgrade in-service teachers are given in the WSP colleges the annual per-pupil unit costs are expected to rise to 7,000 zloty, of which 5,000 zloty are provided by the colleges and 2,000 zloty to cover replacement, transport and the other social costs of students. The unit cost of a graduating student is thus expected to be 40,000 zloty. Altogether, the total cost

1. This may seem to confuse the issue, as the study was made to find the cost of raising the quality of *primary*-school teachers. However it was thought that primary teachers should have the training at present received by the secondary-school teachers, and so the cost of the training of future primary teachers was based on the cost of systems of training of secondary teachers. (IIEP)

2. 47,000 zloty for the SN school, plus 30,000 zloty for the WSP college evening courses.

TABLE 2. Comparison of average cost per graduate for various teacher-training systems (zloty)

System	Graduate cost of: Secondary general course	Teacher-training school [1]	SN school	SN school (evening)	SN school (special)	WSN college	University or WSP college	WSP college (evening)	WSP college (special)	Total graduate cost
Secondary general courses	12 000									36 500
Teacher-training school		36 500								47 000
SN school	12 000		35 000							44 500
SN school (evening)		36 500		8 000						46 000
SN school (special)		36 500			9 500					72 000
WSN college	12 000					60 000				132 000
University or WSP college	12 000						120 000			74 500
WSP college (evening)		36 500		8 000				30 000		76 000
		36 500			9 500			30 000		77 000
	12 000		35 000					30 000		84 500
WSP college (special)		36 500		8 000					40 000	86 000
		36 500			9 500				40 000	87 000
	12 000		35 000						40 000	

1. Since the teacher-training schools will produce teachers only up to 1970, these figures will not be used in the forecasts for 1971-75.

for a teacher upgraded through the special course in the WSP colleges is 87,000 zloty.[1]

Table 2 gives a comparison of the average cost per graduate for various teacher-training systems.

II. Cost forecast of the teacher-training programme

The teacher-training programme is based on a projection of primary teacher needs for the period 1971-75.

A. Teacher demand

The teacher demand in primary schools is estimated on the basis of the following assumptions:

1. That the eight years' compulsory education is maintained up to 1975; it has been suggested that compulsory school should be extended to nine years, but this was rejected by the government. It was thus very easy to estimate the total enrolment on the basis of the present demographic parameter.
2. That a slight improvement in the pupil/teacher ratio would take place over the forecasted period.
3. A study by Mr. Iwanowski[2] of teacher wastage over the period 1961-64 showed that it amounted to 95,000 teachers. Two categories of wastage were distinguished: more than 2.5 per cent[3] of school teachers had resigned; in addition 0.5 to 3.4 per cent of the teaching force were dismissed. In the estimation of teacher demand it was therefore necessary to take into account the wastage which was likely to occur in the stock of teachers.
4. The projected evolution of graduate teacher supply has to be corrected to take into account the fact that new graduate teachers would not enter the teaching force under certain circumstances; for example married women teachers who could not find a position in the same locality as their husband. This sort of wastage is very high (from 8 to 15 per cent) according to Mr. Iwanowski.
5. In the estimation of teacher needs, no special reference was made to teachers who were in the process of being upgraded either to the SN schools or to the teacher-training college, since in both cases they should be considered as being upgraded in service.

1. 47,000 zloty for the SN schools, plus 40,000 zloty for the WSP college special courses.
2. W. Iwanowski, *Kadry Nauczycielskie* (The teaching force), Warsaw, 1968.
3. It is assumed that this figure includes those teachers who have reached retirement age (IIEP)

6. It was assumed that fewer repeaters and fewer drop-outs would improve the supply rates to meet projected demands.

On the basis of the above set of hypotheses the aggregate total demand for teachers over the period 1964-75, using statistics provided by the Ministry of education, amounted to 182,000 including teachers in vocational schools, (118,000 up to 1970 and 64,000 for the period 1971-75). It is obviously necessary to take into account the recruitment of teachers coming from the teacher-training schools only up to 1970, as the last intake was in 1965.

B. Costing alternative teacher-training programmes

We will examine four possible solutions to the problem of improving the quality of primary-school education in Poland, concluding with the one which was finally accepted by the Polish government.

The report is mainly concerned with recurrent unit costs; no capital costs have been computed and this is a limitation to the approach adopted, since capital costs could affect the order of magnitude of each solution and might thus lead to different conclusions.

Another methodological problem to be considered is related to the fact that the unit costs used here have not been adjusted to take into account the evolution of price indices. In fact, the total estimates are based upon unit costs calculated for the period 1961-65 and there is no reason to believe at the outset that the average per-pupil cost evolution will be parallel for each system of teacher-training envisaged.[1] It is with these reservations in mind that one should interpret with great care the conclusions of the following calculations.[2]

1. *The cost of training 118,000 teachers up to 1970*

Out of 118,000 teachers needed up to 1970, 23,200 would graduate from higher education. For these teachers the unit cost is about 130,000 zloty per graduate, assuming an improvement in the productivity of education. This gives a total cost of 3,000 million zloty.

The SN institutions would train 51,000 teachers at 45,000 zloty per graduate; assuming an improvement in the productivity of these schools, the total cost would be 2,400 million zloty.

Finally, 43,800 teachers would be trained through the teacher-training schools, where the cost per graduate is approximately 36,500 zloty. Therefore the total cost of producing these teachers would be 1,500 million zloty.

1. Although it is true that teachers' salaries form the main part of the cost of teacher training, non-salary costs (hostels, transport, etc.) are important enough to cause significant differences in the evolution of unit costs. (IIEP)

2. The supply pattern up to 1970 was taken as set and no alternative was costed. The choice of courses presented to the government applied to the period after 1970. (IIEP)

Altogether the cost of producing 118,000 teachers before 1970 would be about 6,900 million zloty.

It had been estimated that during the period 1964-70, 1,500 teachers would complete evening courses (SN) at the unit cost of 8,000 zloty and a total cost of 120 million zloty. In addition, 70,000 teachers would be upgraded through special courses, where some increase in productivity was expected with the effect of reducing the unit cost to 9,000 zloty. This means that upgrading 70,000 through special courses (SN) would cost about 630 million zloty.

About 2,000 teachers would be upgraded through evening courses in the WSP colleges, where no improvement in productivity was expected and where the cost per graduate would remain 32,000 zloty. The total cost of upgrading these teachers would amount to 60 million zloty. In addition, 4,000 teachers would be upgraded through special courses in the WSP colleges at the unit cost of 40,000 zloty and a total cost of 160 million zloty.

Altogether, the non-day teacher-training programme would cost about 1,000 million zloty for the period 1964-70.

2. *The cost of alternative solutions 1971-75*

Four alternative solutions for the training of primary school teachers were costed.

Alternative I. This consisted in upgrading teachers recruited as graduates from the SN schools (starting in 1968/69) by four or five years of training in higher education establishments—WSP colleges or universities. The SN schools would be closed in 1974, to be replaced by the WSN colleges. Under this alternative it was assumed that the SN schools would produce 25,000 graduates up to 1973, the remaining 39,000 (64,000 – 25,000) being produced by the universities or WSP colleges. This hypothesis seems rather unrealistic when one compares the pattern of production of the universities and WSN colleges over the period 1964-70 (3,300 graduates per annum) with the 39,000 teachers expected over the period 1971-75; even if during 1971/72/73 it were possible to produce 4,000 graduates per annum, there would still be the need for another 27,000 for the two final years of the period, i.e. 13,500 per annum. This would be far beyond the capacity of the higher education establishments. Nonetheless, this alternative was costed in order to give an idea of the maximum cost of teacher-training, using the most expensive of the existing systems.

If the 25,000 graduates from the SN schools cost only 40,000 zloty each, which presupposes an increase in the productivity of these schools, the total cost of these graduates would be 1,000 million zloty.[1] It was thought that if for a transitional period the upgrading course were shortened from five to four years, and if there were fewer repeaters and drop-outs, then the per-graduate cost would be reduced

1. It is assumed here that 90 per cent of the students starting in the SN schools obtain the diploma and that only 10 per cent drop out. (This is not based on past experience, but is an optimistic assumption.) (IIEP)

to 110,000 zloty. The total cost of upgrading teachers in the WSP colleges would then be about 4,300 million zloty, and thus the cost of this solution is 5,300 million zloty (1,000 + 4,300)—the upper cost limit of the programme.

Alternative II. This consisted of increasing the output of the SN schools up to 1974, thus contributing 50,000 graduates over the period 1971-75. The cost of training these graduates would be 2,000 million zloty (40,000 zloty per graduate). The 14,000 additional teachers needed would be provided by the universities and WSP colleges at the unit cost of 110,000 zloty or a total of 1,500 million zloty. Under these circumstances, the total cost of the teacher-training programme would be 3,500 million zloty. (It was between the upper and lower limits of 3,500 million and 5,300 million zloty that the authors of this analysis tried to find the most realistic alternative.)

Alternative III. This was based on what was thought likely to be the maximum feasible output of teachers from the higher education establishments. Up to 1970 the average annual number was 3,300; after a survey in the universities and WSP colleges it appeared that the upper limit of annual output from these establishments would be 5,000 graduates after 1970. This average assumes the doubling of the 3,300 graduates in 1970 to 6,600 in 1975. For many reasons it was not considered possible to further expand the universities and WSP colleges during this period.

It follows that the maximum number of graduate teachers coming from higher education establishments would be 24,000. This leaves 40,000 to be made available during 1971-75. One suggestion was to prepare 40,000 teachers in the new WSN teacher-training colleges of three years' duration; this was a new category of college for which no cost estimates were available. In 1968 no colleges of this type were actually built, therefore it would have been unlikely that they would start producing regularly in 1971. Nevertheless, (as shown in table 2), in order to illustrate the cost of such a programme, the authors estimated the likely unit cost as being 17,000 zloty per student per year (60,000 per graduate). This estimate was based on comparisons with costs in general secondary schools, and allowance was then made for the generally higher costs of teacher-training; the final figure was 69,000 zloty per graduate. Thus the cost would be 2,760 million zloty (40,000 × 69,000) for 40,000 graduates This, plus the cost of training 24,000 students through the universities and WSP colleges for three years (24,000 × 110,000 zloty), gives a total of 5,400 million zloty. Thus this alternative is more expensive than the first alternative, which was considered as being the upper limit of the acceptable cost of the programme.

Alternative IV. This was established on the basis of the following assumptions:

1. The total number of teachers trained in higher education establishments was expected to be 24,000 during the planned period.
2. The new WSN teacher-training colleges would be introduced by adapting existing SN schools, but primary-school teachers would still be trained in the SN schools with a normal course of two years' duration.

3. The results from a detailed case-by-case analysis of the cost of this transformation and the available teaching staff; it was decided that in 1968 the first three WSN colleges would be opened and the rest in the following years. These colleges would prepare 14,000 teachers over the planned period 1971-75. The number of graduates from the WSN colleges would increase from 1,200 in 1971 to 4,000 in 1975. The remaining 26,000[1] would be supplied by the SN schools. The number of graduates from the SN schools would diminish from 7,000 in 1971 to 4,500 in 1975.

It must be pointed out that the target of upgrading the whole stock of teachers to a higher education standard will not be reached by 1975, since out of 64,000 teachers only 38,000 (24,000 + 14,000) will have reached the higher education level. The cost of this alternative is estimated as follows:

24,000 teachers	× 101,000 =	2,640 million zloty
26,000 teachers	× 40,000 =	1,040 million zloty
14,000 teachers	× 60,000 =	840 million zloty
Total:		4,520 million zloty

This is 780 million zloty less than the acceptable upper cost limit for the programme. Although not the cheapest variant, it has been accepted because of its practical feasibility. In fact the educational authorities in Poland have taken it as the basis for introducing the upgrading of the teaching force in the coming years.

III. Commentary by IIEP

Some useful lessons from this case study

The case is of special interest to the IIEP series because it illustrates how cost analysis can help policy-makers to compare the pro's and con's of alternative approaches open to them in pursuing a given educational objective. Perhaps its first important lesson is to remind us that educational planners and policy-makers should not be bound by a single traditional way of doing things; there are usually alternative ways to pursue any educational objective and one of the important tasks of planning is to identify and compare these options in order to choose among them as wisely as possible. Doing so, however, is rarely a simple matter of arithmetic. As we have seen, a variety of important considerations, variables and constraints—often not easily measurable—must be taken into account in weighing the relative merits, feasibility and implications of each alternative

1. 64,000 − 24,000 − 14,000.

approach. Cost analysis provides only some of the important considerations and in any event it does not *replace* human judgment; it simply *informs* it better.

In the present case the central objective was to improve the quality of elementary education over the next five years through the route of improved teacher training. Hence the central question for planning was how best to do this, given the current condition and potentialities of existing teacher-training programmes, the possibilities for introducing new or modified programmes, and given also the practical constraints imposed by earlier policy decisions and by limitations of time, money, human and physical resources and basic data.

One important 'given' in this case was the policy decision, previously made, that in the future all elementary teachers should have 'third-level' education. This meant phasing out the 'second-level' training, then being given by existing teacher-training schools, which posed the question of how to absorb their training load into appropriate third-level programmes. Another basic question was what relative emphasis should be given to upgrading the present stock of teachers as against improving the quality of newly trained teachers (who for many years to come would constitute a fraction of the total stock). Answers to these questions in turn hinged on still other questions. How many additional teachers would be needed? Could the present universities and teacher-training colleges meet this requirement? If not, could they be expanded rapidly enough, and at what cost? What innovations might be used to train good quality new teachers and to upgrade existing ones, and what would be their cost and feasibility? Could something be done to reduce the high drop-out and repeater rate in teacher training? If so, how would this affect the output and cost of graduates? What sorts of in-service training would be most effective and economical?

In presenting the best estimates they could of the comparative cost and feasibility of the different approaches to improving teacher training they shed valuable light for the decision-makers on the options available to them. But because of the limited scope of their inquiry, two important questions for the decision-makers went unanswered. First, how would the final 'products' of these alternative approaches compare in quality? By tacitly assuming that there would be no significant difference in the quality of teachers coming out of each programme, the study left it to others to make their own judgment on this crucial point. Second, what would be the relative consequences of these alternative solutions, not simply for teacher-training costs but for the future operating costs of the elementary schools? Would they result in quite different rates of promotion for existing teachers and in different patterns of distribution of teachers as between the low end and high end of the salary scale? If so, their ultimate cost consequences could differ greatly, even if their short-run costs appeared to be quite similar. This can be an enormously critical question, especially for developing countries whose teacher salary structures have a wide spread.

What lessons does this case study offer concerning methodologies of cost estimation? One point worth noting is that two types of unit costs were calculated—annual cost per student enrolled and cumulative cost per successful graduate. For the decision-making purposes at hand, clearly the most relevant and meaning-

ful of these two measures was the cost per graduate. Because of the high drop-out and repeater rate in teacher training, the actual cost per graduate was considerably higher than one might infer from the annual average cost per student enrolled. In the circumstances the latter average figure had little useful meaning, the more so because it was not broken down by successive years of training.

The study made the assumption that there would be a decline in these high drop-out and repeater rates, which had a substantial downward influence on the estimated cost per graduate. While this seems a reasonable enough assumption, one would have hoped for an explanation of how this decline was to be accomplished and whether this in itself might not entail certain extra costs.

One would also have liked to see more attention given to the practical administrative and logistical requirements and feasibility of these different schemes. The 'special course' approach to in-service training, for example, had the evident great advantage of keeping teachers in service and upgrading them without reducing the total supply. Yet one suspects that this system might impose some heavy practical problems of planning and rearranging school timetables and curricula. Evening courses, on the other hand, seemed seductively low in cost, yet experience had evidently shown that poor attendance cuts their actual productivity, and that they are logistically impractical in most rural areas.

The study made a clear distinction between what it termed 'institution costs', meaning the *total* real costs involved in training teachers, and the 'partial money costs', which show up in the Ministry of education budget. There may be a considerable difference between the two, taking the form, for example, of medical and dental services to students borne by other governmental budgets; costs of books, clothing and transportation paid by parents: and the salary costs borne by society for teachers undergoing in-service training and who must be temporarily replaced in the classroom.

One must also, for most purposes, also take capital costs into account. In the present case, the analysts handled the capital costs of equipment ingeniously and reasonably by amortizing them over ten years and adding the amortization cost into recurrent costs. But on the other hand they appear to have ignored capital costs of construction altogether. This omission, however, is not likely to be too serious in this type of case. As we have seen in other case studies, educational construction costs, spread over a substantial period of depreciation, are relatively minor in size compared to the heavy recurrent costs involved in this labour-intensive enterprise of education. Moreover, unless there is reason to expect wide differences among alternative programmes in the amount of capital investment required per student, the comparison of their respective costs is not seriously distorted by omitting amortization of capital. But if, on the other hand, one were mainly concerned about the allocations to education from the national capital budget, then obviously the omission of construction costs would be a serious error.

Perhaps a more serious potential source of error in this study was the tacit assumption that the unit cost relationships as of 1961-65 between these alternative programmes would remain the same in the future. It could well turn out, however, that the evolution of the price structure in the future might have quite different

impacts upon the costs of these various alternative methods of teacher training. To attempt to forecast such changes in price and cost relationships, however, is at best a hazardous undertaking; hence one can be forgiven the convenient assumption of constancy.

All in all, despite the rather simplistic analytical methods and assumptions used, and despite the relatively crude nature of the basic data, the cost comparisons obtained in this study undoubtedly cast useful light upon the choices to be made. We would emphasize, however, that without closer consideration of the corresponding educational results likely to be obtained by each alternative approach, and with no estimate of their likely consequences for future teacher costs in school operation budgets, the decision-makers were lacking some critically important information.

We do not know whether they were keenly aware of these gaps and thus made explicit judgements of their own on these matters in arriving at their final decision. But we do know that the choice which the government made was not the least costly alternative, at least judging by the evidence provided by the cost analysis that was presented to them. Interestingly enough, the more costly alternative which was chosen provided for relatively little upgrading of existing teachers during the period in question and for only 38,000 out of 64,000 newly trained teachers to receive third-level training.

Unfortunately for those interested in studying the value of cost analysis for decision-making it is sometimes virtually impossible to determine retroactively just how large a rôle, if any, a particular cost analysis played in arriving at a major educational decision, and what other important considerations were weighed in the balance.

Appendix

TABLE 1. Distribution of pupils and students in different types of schools and colleges (in thousands)

School year	Pre-primary	Primary	General secondary	Workers' schools		Vocational	Higher
				Primary	General secondary		
1946/47	201.5	3 283.4	228.4	30.7	43.2	286.7	86.5
1949/50	288.6	3 352.9	221.4	57.0	38.1	558.2	115.5
1955/56	370.9	3 386.4	201.4	71.8	53.8	503.0	157.5
1956/57	376.5	3 654.6	202.7	67.8	56.2	495.4	170.3
1957/58	344.7	3 924.2	195.1	45.6	50.6	491.2	162.7
1958/59	349.2	4 240.1	199.2	55.3	60.2	547.4	156.5
1959/60	364.2	4 574.1	214.3	61.1	66.6	645.2	161.0
1960/61	389.2	4 827.6	260.4	87.8	76.2	784.2	165.7
1961/62	409.5	4 994.4	298.4	86.4	83.5	978.2	172.4
1962/63	433.0	5 117.3	339.5	86.9	93.6	1 183.6	190.3
1963/64	440.7	5 181.7	378.5	78.0	103.6	1 372.8	212.6
1964/65	448.7	5 207.9	405.2	71.6	116.5	1 534.1	231.2
1965/66	453.4	5 176.6	426.8	59.6	129.3	1 671.0	251.9
1966/67	464.7	5 527.0	322.7	46.8	133.9	1 629.2	274.5
1967/68	480.1	5 706.3	306.1	44.9	136.9	1 500.5	288.8

SOURCE *Statistical yearbook of education*, 1967/68, p. 4, Warsaw, Central Office of Statistics.

NOTE As a result of the extension of primary education to eight years' duration as from 1966, there is a noticeable decrease in the secondary-school enrolment.

TABLE 2. Full-time teachers in primary schools, general secondary schools, technical schools and higher educational institutions

School year	Primary schools		General secondary	Technical	Higher
	Total	Of which rural			
1946/47	66 643	43 414	—	—	—
1948/49	76 319	49 827	—	—	—
1955/56	102 501	68 594	10 412	31 135	18 287
1956/57	109 618	70 430	11 006	31 814	19 164
1957/58	119 791	74 111	11 433	31 535	19 381
1958/59	130 062	78 339	11 483	31 406	19 401
1959/60	140 324	83 084	11 660	32 700	19 269
1960/61	145 743	85 906	12 062	33 898	19 202
1961/62	151 412	88 791	12 625	36 415	19 249
1962/63	156 181	90 531	13 569	40 252	19 628
1963/64	159 710	91 850	14 831	44 998	21 083
1964/65	165 447	95 838	15 411	49 737	21 557
1965/66	171 745	99 574	15 848	55 842	22 960
1966/67	189 180	109 245	15 261	57 570	24 411
1967/68	201 382	115 558	15 044	57 317	26 079

SOURCE *Statistical yearbook of education, 1967/68*, p. 22, op. cit.

TABLE 3. Percentage distribution of teachers according to their training

Category	Year	Nature of training			
		Higher	SN school	2nd. degree teacher-training	No secondary teacher-training
Total teaching force	1962	18.0	18.6	60.6	3.1
	1963	18.3	21.1	56.9	3.7
	1964	18.1	27.9	50.6	3.4
	1965	16.2	32.4	47.3	4.1
	1966	15.7	37.4	42.3	4.6
Teachers in primary schools (see note below)	1962	4.7	21.0	72.1	2.2
	1963	5.1	23.6	69.2	2.1
	1964	4.7	32.1	61.5	2.7
	1966	4.9	46.7	46.9	1.5
Teachers in general secondary schools	1962	91.9	5.9	1.9	0.3
	1963	86.9	9.6	2.9	0.6
	1964	86.3	10.6	2.7	0.3
	1965	85.0	11.9	2.7	0.4
	1966	85.9	11.2	2.3	0.6
Teachers in teacher-training schools	1962	90.5	7.0	1.9	0.6
	1963	89.9	8.0	1.7	0.4
	1964	87.1	9.6	2.5	0.8
	1965	87.6	9.6	2.3	0.5
	1966	88.0	9.5	2.0	0.5
Teachers in vocational schools	1962	51.0	12.2	25.6	11.2
	1963	48.2	14.0	21.6	16.2
	1964	46.4	15.4	22.6	15.6
	1965	45.5	19.2	13.9	21.4
	1966	45.3	21.1	11.5	22.0

SOURCE Calculated from data in W. Iwanowski, *Kadry Nauczycielskie*, op. cit.

NOTE Figures for primary-school teachers for 1965 are not available. For 1966, the 12.5 thousand teachers employed full-time in primary schools but not completing the eight-year programme are not included.

TABLE 4. Current expenditure on education financed by the national budget (current prices, in thousand million zlotys)

Year	Expenditure	Year	Expenditure
1955	8.1	1962	16.8
1956	9.2	1963	18.1
1957	10.6	1964	20.6
1958	11.5	1965	21.1
1959	13.0	1966	23.6
1960	14.1	1967	25.2
1961	15.3		

SOURCE *Statistical yearbook of education, 1945-1966/67*, p. 40 and *1967/68*, p. 26, Warsaw, Central Office of Statistics.

TABLE 5. Trend in investments in education (at 1961 prices, in million zlotys)

Year	Amount	Year	Amount
1957	2.1	1963	4.3
1958	2.6	1964	4.4
1959	3.3	1965	4.6
1960	3.9	1966	4.3
1961	3.7	1967	4.2
1962	3.9		

SOURCE *Statistical yearbook of investments and equipment*, 1946-66 and data from *Statistical Yearbook, 1968*, Warsaw, Central Office of Statistics.

TABLE 6. Capital expenditure by type of education (in million zlotys)

Type of education	Annual average		1966	1967
	1956-60	1961-65		
General education institutions	2,067	3,252	2,102	1,756
Vocational schools	388	919	1,259	1,335
Higher education institutions	354	512	711	851

SOURCE *Statistical yearbook, 1968*, op. cit. p. 93.

TABLE 7. Enrolments and graduates of teacher-training institutions

School year	Schools	Sections	Students		Graduates (of preceding year)
			Total	Female	
1. *New teachers*					
(a) Teacher-training schools					
1958/59	148	—	39 816	—	7 546
1959/60	143	1 154	37 673	31 222	6 988
1960/61	139	1 092	38 956	31 769	7 290
1961/62	134	1 067	41 039	33 015	5 562
1962/63	119	1 109	43 232	34 572	5 305
1963/64	122	1 157	44 808	35 799	6 469
1964/65	116	1 153	45 285	36 162	7 901
1965/66	110	1 020	39 427	31 924	8 815
1966/67	105	781	29 132	23 756	7 823
1967/68	100	547	19 829	16 328	8 145
(b) Teacher training for pre-primary					
1958/59	38	—	6 407	6 407	35
1959/60	36	237	7 334	7 334	1 126
1960/61	33	225	7 582	7 582	1 216
1961/62	32	236	8 435	8 435	953
1962/63	35	270	9 862	9 862	903
1963/64	36	299	11 051	11 051	1 160
1964/65	39	320	12 184	12 183	1 484
1965/66	40	335	12 727	12 727	1 986
1966/67	48	362	13 505	13 505	2 019
1967/68	49	380	13 775	13 775	2 106
(c) Technical teacher-training schools					
1965/66	21	81	2 983	105	202
1966/67	22	99	3 456	126	639
1967/68	21	102	3 468	118	655
(d) SN schools					
1958/59	34	222	7 406	4 086	2 471
1959/60	41	265	9 287	5 112	3 191
1960/61	52	325	11 535	6 581	4 293
1961/62	52	380	13 898	7 943	4 906
1962/63	56	432	15 105	8 984	6 292
1963/64	58	485	18 303	10 566	6 187
1964/65	62	550	22 186	14 787	8 016
1965/66	60	581	23 241	16 558	9 503
1966/67	59	566	22 574	16 100	8 974
1967/68	59	568	22 715	16 237	9 690
2. *Upgrading of teachers by evening courses*					
(a) Teacher-training schools					
1963/64	7	10	400	350	334
1964/65	4	4	188	157	166
(b) Teacher-training for pre-primary					
1963/64	3	3	85	85	50
1964/65	2	3	86	86	69
(c) SN schools					
1961/62	3	8	334	267	160
1962/63	3	7	299	241	164

School year	Schools	Sections	Students		Graduates (of preceding year)
			Total	Female	
1963/64	41	183	5 918	5 139	3 434
1964/65	27	108	4 065	3 593	1 799
1965/66	22	104	4 148	3 758	1 821
1966/67	20	92	3 468	3 187	1 721
1967/68	19	69	2 630	2 376	1 751
3. *Upgrading of teachers by special courses*					
(a) Teacher-training schools					
1958/59	×	—	859	588	523
1959/60	×	—	5 289	3 621	3 006
1960/61	×	106	4 226	3 011	2 199
1961/62	×	53	2 272	1 633	1 653
1962/63	×	51	2 137	1 581	1 515
1963/64	×	55	2 409	1 901	1 169
1964/65	×	40	1 957	1 601	1 430
1965/66	×	25	1 158	987	921
1966/67	×	55	2 618	2 242	1 987
1967/68	×	47	2 057	1 769	—
(b) Teacher-training for pre-primary					
1959/60	×	—	190	190	10
1960/61	×	9	337	337	51
1961/62	×	7	234	234	100
1962/63	×	21	670	670	69
1963/64	×	25	770	770	272
1964/65	×	36	938	938	270
1965/66	×	32	1 268	1 268	278
1966/67	×	31	967	967	242
1967/68	×	21	693	693	—
(c) Technical teacher-training schools					
1965/66	×	3	90	6	90
(d) SN schools					
1958/59	×	—	9 556	5 488	1 820
1959/60	×	—	10 869	6 411	2 291
1960/61	×	352	10 883	6 678	2 411
1961/62	×	483	17 004	11 132	3 623
1962/63	×	705	27 026	18 556	3 927
1963/64	×	722	27 459	18 534	15 740
1964/65	×	634	25 020	17 787	11 287
1965/66	×	756	28 679	21 503	12 118
1966/67	×	773	30 118	23 651	12 460
1967/68	×	652	28 671	23 997	—

SOURCE *Statistical yearbook of education, 1944/45-1966/67*, pp. 349-350, 370. *Statistical yearbook of education, 1967/68*, p. 310 and data from the *Statistical Yearbook* for each year, op. cit.

TABLE 8. Enrolments in, and graduates of, teacher-training colleges (including evening courses)

School year	Enrolments				Graduates	
	Total	Female	First grade	Final grade	Total	Female
1958/59	3 235	1 689	947	—	418	193
1959/60	3 300	1 923	990	598	434	187
1960/61	3 626	2 180	1 128	625	434	217
1961/62	4 238	2 595	1 376	—	448	263
1962/63	7 053	4 387	1 926	865	346	173
1963/64	8 139	4 947	2 258	940	764	426
1964/65	9 275	5 861	2 638	1 232	815	489
1965/66	9 666	6 356	2 342	1 372	1 030	582
1966/67	10 520	6 843	2 657	1 440	1 276	—
1967/68	11 193	7 282	2 685	1 905	1 241	—

SOURCE *Statistical yearbooks* for the relevant years, op. cit.

TABLE 9. Enrolments in, and graduates of, teacher-training colleges (special courses)

School year	Students				Graduates
	Total	Female	First grade	Final grade	
1958/59	2 801	1 411	848	—	20
1959/60	3 465	1 616	958	281	100
1960/61	4 463	2 106	1 235	541	189
1961/62	5 215	2 674	1 395	679	244
1962/63	3 261	1 694	558	460	278
1963/64	4 377	2 138	693	559	337
1964/65	5 134	2 620	866	664	349
1965/66	5 783	2 961	644	893	410
1966/67	6 555	3 556	1 487	1 005	573
1967/68	6 580	3 621	1 518	965	755

SOURCE *Statistical yearbooks* for the relevant years, op. cit.

Brazil *16*

Costing an expansion programme for secondary education in Rio Grande do Sul

prepared by R. C. Fachin

This study was prepared by R.C. Fachin, from the State Secretariat of Education and Culture, assisted by Jacques Hallak, IIEP. The Institute gratefully acknowledges the helpful co-operation of the Council of Education of Rio Grande do Sul in providing the basic data for the study.

Introduction

In 1967, the State Council of education, the organization legally responsible for educational plans in the State of Rio Grande do Sul, set about preparing a comprehensive educational plan.

The federal government of Brazil had selected four States for the programme for middle-level education to be financed by USAID; one of these was Rio Grande do Sul. With financial support from the federal Ministry of education a group of experts began working on the project in each State. In the case of Rio Grande do Sul, the State Council of education sponsored the working group set up in September 1967 and submitted its project report four months later.

The aim of this case study is to describe the techniques followed in the preparation of the secondary-education development project in Rio Grande do Sul.

The main focus will be on cost estimates, expressed in terms of both real resources (teachers) and finance. The purpose of the study is to show how, in a concrete situation, a group of experts has costed an educational project with very limited and inadequate data, and related it to the general educational plan.

In Part I, the emphasis is on the methodological difficulties involved; the steps followed in costing the project are then described. Part II deals with enrolments; Part III with teacher requirements; Part IV, with recurrent expenditures; and Part V, with capital expenditures. The conclusion attempts an evaluation of the methods used.

I. Methodological difficulties

The first problem faced by the group was whether to develop a comprehensive plan or one for secondary education only. There were no definite sources of finance, apart from the budgetary ones, for a comprehensive plan, whereas money was available for the secondary-education development project which, in addition, would probably be less time-consuming than the global plan. However, a decision was finally taken to aim at a comprehensive plan, and to pursue more detailed studies on secondary education if the global plan could not be completed in time. As it turned out, methodological difficulties at the elementary and lower-secondary levels somewhat jeopardized a complete analysis of other parts of the plan; nevertheless, the decision was realistic and was worked out.

The second problem was related to the fact that the group did not know how much federal financial support the State would get, since the whole programme was to be co-ordinated by the federal group. This meant that the projects originating from the four States would have to be combined into a single financial proposal.

In principle, each State could ask for funds for either recurrent or capital expenditures, according to their group's definition of needs, since there was no policy on this point, and the federal group would *co-ordinate* the four projects and consolidate them within the total amount of funds available. The State working group decided to develop the project in such a way that the State could meet recurrent expenditures and get financial aid for capital expenditure. If the State asked for help in meeting recurrent expenditures, problems would arise when financial assistance came to an end. In order to take part in the federal programme, the State had agreed to increase the share of education in the budget by 2 per cent per year from its existing level of 20 per cent, in order to justify a request for capital expenditure only from the federal government. This decision proved realistic when the federal government agreed to finance capital expenditure and teacher training.

The third problem was to decide on the amount of resources available for the programme from State funds, by projecting the State's income and expressing all data in current prices not subject to inflation.

The fourth problem pertained to forecasts of enrolments. How should the group define enrolment targets at the elementary, lower-secondary and upper-secondary levels? One alternative was to project enrolments by extrapolating the trend of the last ten years. However, the only data available were global enrolment, approvals to fifth grade, and preliminary data of the demographic census of 1960.[1] The problem of forecasting enrolments both at the primary and lower-secondary levels was solved by using a simple model of enrolment projections which set targets for each year of the plan on the assumption of reduced repetition and drop-out rates, which in turn depended on improving quality at those levels. The forecasts of enrolments at the upper-secondary level were based upon a projection of manpower requirements.

The fifth problem, and perhaps one of the most difficult, was to estimate the number of teachers needed to implement the programme, not only in the new schools which were to be created, but for the system as a whole. Tentative programmes of administrative reforms were devised to reduce the need for teachers, but these programmes did not prove successful. Details will be given later in this report.

II. Forecasts of enrolment

Forecasts of enrolments were made for the three levels, from primary to upper-secondary, with *separate estimates of the share of the public sector.*

1. The group was faced with the necessity of estimating most of the data needed, because they were not available.

In the case of *primary and lower-secondary levels*, the projections used a so-called 'cultural model', which was accepted as a basis for the forecast by the *expert group from the State Council*. This model is, in fact, a straightforward set of computations linking enrolment targets with hypotheses on quality improvement, namely, decrease of drop-out, wastage and repeater rates, etc. The hypotheses and the 1976 targets resulted from consultations among the members of the State Council. A series of adjustments was then made to establish enrolment estimates for the intermediate years, so that there would be a steady increase in the number of pupils enrolled. It is worth mentioning at this stage that, apart from data on global enrolments, which were the only *observed* data, all the figures used were no more than reliable estimates. (Table 3 in the Appendix gives the detailed enrolment forecast year by year and for each grade over the period 1964–76.)

In the case of the upper-secondary level, an effort was made to link the likely educational output for a number of enrolment hypotheses with manpower demand projections extracted from the ten-year federal plan. In addition, the output of the lower level was taken into account in the estimate of the new intake into the upper-secondary level.

1. For the total enrolment in upper-secondary level, three assumptions were made:[1]

   (1) Knowing that, in 1964, graduates in the lower level (4th grade) represented 85 per cent of the general enrolment of that grade, it was estimated that, for 1976, lower-level graduates would constitute 90 per cent of general enrolment at that grade, thus assuming some qualitative improvements.[2]

   (2) Several national meetings of educators expressed a desire that 70 per cent of lower-level graduates should have access to the upper level. If such a percentage is accepted, 62,000 pupils should be enrolled at the first grade in the upper level in 1976.

   (3) Knowing that, in 1964, first-grade pupils of the upper level represented 44 per cent of total enrolment at that level, it was estimated that, in 1976, this proportion would decrease to 38 per cent;[3] from these figures, the distribution of pupils between the various grades was computed.

2. For the agricultural upper level, historical projections of the last five years were used, assuming that programmes of agrarian reform would be implemented, thus giving enough employment to such technicians.

3. For the industrial upper level, the projections were based upon a special study

1. It is interesting to note that the hypotheses concerning enrolment at the upper level were arrived at after enrolment at the lower level had been estimated, and after it became clear that a larger increase in upper-level would not get sufficient resources in the State budget.

2. No explanation is given how such improvements are to be achieved.

3. Such a decrease would result from a more balanced distribution of pupils in the various grades at the upper level.

of the estimated contribution by the State to the industrial output of the country as a whole.

4. For teacher-training upper-level schools, use was made of the targets set up for primary education, and it was assumed that 70 per cent of graduates would actually enter the teaching force.

5. On the basis of the total as defined in paragraph 1 above, and the estimates given in paragraphs 2, 3 and 4, it was possible to compute the enrolment in upper secondary (academic) and upper secondary (commercial).

Tables 1, 2 and 3 in the Appendix give the detailed enrolment forecast year by year and for each grade over the period 1964–76.

III. Estimating teacher requirements

This step turned out to be one of the most difficult. The three following methods were used and the results are given in Table 4 in the Appendix.

First calculation

To start with, a very simple calculation was made of the number of teachers needed if the present pupil/teacher ratio of 14:1 in lower secondary and 7:1 in upper secondary were maintained. On this assumption, the number of teachers needed rose from 13,302 in 1968 to 21,067 in 1971. But this method was soon abandoned due to its crudeness and the difficulty of using its results, particularly in estimating the magnitude of teacher-training programmes for the new schools.

Second calculation

In this approach, teacher needs were estimated according to the average weekly hours of each type of school.

The probable number of classes at the lower level was obtained by dividing the estimated enrolments by 30, classes of 30 pupils being considered as the right average at that level; the weekly average hours by type of school were assumed to be the following:

	Lower secondary	*Upper secondary*
Academic	25	25
Normal	30	30
Industrial	33	40
Agricultural	34	40

Commercial	23	23
Orientado	28	—
Comprehensive	—	37

The resulting estimate of the number of classes was multiplied by the average number of weekly teaching-hours in each type of school. These are given in Table 1 for various types of *ginásio*. Lastly, the total teacher requirement was obtained by dividing the number of weekly hours by 15, which was considered as the desirable and possible number of working hours of each teacher in the State system.

TABLE 1. Lower-level secondary: number of hours per week and per type of school

Type of school	1968	1969	1970	1971
Academic	57 150	54 500	44 825	32 325
Normal	5 280	4 500	3 690	3 180
Industrial	7 590	7 590	6 138	4 389
Agricultural	2 142	1 904	1 700	1 122
Commercial	5 750	5 198	4 899	4 600
Orientado para o trabalho (polivalente)	17 249	37 968	68 488	104 720

The same method was used for estimating the number of teachers needed at the upper level. Altogether, for both lower- and upper-secondary levels, the number of teachers needed is 8,428 in 1968, 9,887 in 1969, 11,284 in 1970, and 12,995 in 1971.

Third calculation

When the plan reached the federal group, these figures did not raise any serious problems, since they suggested that the State would not need new teachers to implement the plan. The present level of teacher training was considered sufficient, particularly in view of the declared intention of getting the teachers to agree to working extra hours so as to achieve the desired total number of hours per teacher.

It then fell to the federal group to see if the estimates were realistic in the light of the actual situation. At the time, five months after gathering all the data necessary for the preparation of the plan, the State was already trying to relieve teachers from administrative and non-teaching duties. However, this attempt was not very successful and, in fact, only a small number of teachers was actually released from administrative functions. The federal group concluded, therefore, that the calculations were unrealistic and that the State would probably need many more new teachers to implement the plan. The same situation was also found in other States integrated in the secondary-education development project.

The federal group then developed the concept of a 'model' school to be implemented by the plan, i.e., an 800-pupil school operating in two shifts. Certain assumptions were made to calculate the number of teachers needed in each school: it was decided that the hourly teaching load should be 20 hours per week for each teacher, and that the average number of teaching-hours per

week should be 28. Lastly, an assumption was made about the distribution of time between different subjects, which gave the following number of teachers needed:

	Number of teachers needed in each school
Portuguese	5
History and Brazilian and political organization	4
Geography	2
Modern languages	3
Mathematics	4
Sciences	2
Physical education	2
Music, fine arts, etc.	1
Industrial arts	4
Commerce	1
Agriculture	1
Home economics	1
Total	30 teachers per school (800 students, 2 shifts)

The federal group was well advised not to use this approach for estimating enrolments, but simply to apply it to establish teacher-training needs for each *new* school to be built under the financing agreement. Such a calculation reduced the margin of error but, even so, the actual needs for newly trained teachers were under-estimated. The reason for this was that not all the new schools would succeed in meeting the standard for teacher utilization. None the less, the federal group based their estimates on the assumption of a 'model' school, which gave the following results:

TABLE 2. Calculation of teacher requirements, 1968–71

Specification	1968	1969	1970	1971
Number of classes by type of school (*Ginásio* orientado para o trabalho—polivalente)	513	1 130	2 038	3 116
Number of weekly teaching-hours (*Ginásio* orientado para o trabalho—polivalente)	14 364	31 640	57 064	87 248
Number of teachers needed (*Ginásio* orientado para o trabalho—polivalente)	713	1 582	2 853	4 362

A comparison of the estimates of the federal group (third method) with those of the State group (second method) shows that the former are lower than the latter. This is an interesting point, since the federal group began by throwing doubt on the results given by the second method, arguing that it under-estimated teacher needs.

As a matter of fact, the hypotheses on which the federal group's estimates were based (i.e., teaching-hours load, etc.) reflect the *desirable pattern of utilization of teachers rather than the actual situation.* For example, administrative obstacles

made it impossible to change the distribution of teaching-hours and to make better use of teachers to any large extent.

Obviously, none of the methods is entirely satisfactory, since it is necessary not only to take into consideration the desirable number of teaching-hours by each teacher, but also to bear in mind the administrative difficulties involved in making short-term changes. The best estimate might well lie between that given by the above methods and that obtained on the basis of the present working load.

However, in costing the project, the State eventually used the estimates of teacher needs given in the second method.

IV. Estimating recurrent expenditure

Basic data for the calculation of costs are not easily available; there are not enough data on teachers or other personnel employed, on average earnings, on the number of administrative or central office posts. This explains the crudity of the method followed to estimate recurrent expenditure for the global plan. These estimates were made independently for personnel costs and other costs.

Personnel costs

Unit costs have been estimated separately for teachers and for other staff, such as vocational counsellors, teaching supervisors, principals and assistants to the principal. At present, there is no information on payments to principals, which are made from budget allowances to teachers, although supplemented by bonuses paid to each principal and his assistant.

In order to calculate salary levels, a series of assumptions was made. For example, it was assumed that each member of the personnel will get on average three salary increases (salary increases are made every three years of public service up to ten increases). Another assumption relates to vocational counsellors and teacher supervisors, who would receive payments identical with the highest salary level of the Secretariat of education, that of expert in education.

Table 5 in the Appendix shows the unit costs for six personnel categories.

By multiplying the average annual cost unit for teachers and technical and administrative staff by the number of teachers and other personnel needed for the four-year project, the total personnel cost for the operation of middle-level education was calculated.

Salaries for teachers and technical and administrative staff were calculated by assuming a 20 per cent increase for 1968 and 1969, and a 15 per cent increase for 1970 and 1971. These percentages were simply reflecting the forecast of inflation made by the Ministry of planning. This is obviously one of the weaknesses in the preparation of the State project; the estimate of future trends in teachers' salaries should have been made in real terms.

Other expenses

An even less satisfactory explanation could be given for the calculation of other expenses, such as consumable materials and State aid to private schools. In fact, by far the weakest aspect of the global plan was the projection of recurrent expenditures, especially those relating to items other than personnel.

For example, to define needs for materials, average expenditure on materials per pupil was calculated by dividing the budget estimates of expenditure on materials by total enrolment. This estimate of unit cost was then multiplied, every year, by the target number of pupils.

This way of assessing needs for material is unsatisfactory for at least two reasons: first, expenditure in materials as given in the budget does not represent *total* expenditure, since the schools have their own sources of financing, for instance from fees, and these are often used for the purchase of materials; and second, no study was made of the increasing needs for materials as a result of the introduction of the new *ginásio polivalente*.

Table 10 in the Appendix gives the forecast of expenditure for middle-level education in the four-year project. The figures are already deflated by the official price index in an attempt to estimate expenditure in constant prices in terms of the 1967 level. All the estimates of expenditure on materials and other items were obtained by taking future projections of expenditure in money terms and deflating them by the Ministry's projections of the official price index, a procedure which, as already pointed out, is highly unsatisfactory.

TABLE 3. Calculation of school building costs (in NCr$)

Construction unit	No. req.	Unit area	Unit cost	Total cost
Classrooms	8	50 m²	10 000	80 000
Multi-purpose room (drawing)	1	50 m²	10 000	10 000
Special purpose rooms (1 with 60 m², commercial courses; 1 with 60 m², home economics; 2 with 120 m² for industrial arts or agricultural techniques)	2	120 m²	24 000	48 000
Director's office	1	20 m²	4 000	4 000
Secretaries' room	1	45 m²	9 000	9 000
Teachers' room	1	30 m²	6 000	6 000
Library	1	70 m²	14 000	14 000
Counselling office	1	20 m²	4 000	4 000
Covered area for physical education (auditorium)	1	150 m²	30 000	30 000
Cafeteria	1	30 m²	6 000	6 000
Lavatories (blocks)	2	20 m²	4 000	4 000
Inside circulation area	1	155 m²	31 000	31 000
Total		1 370 m²		270 000

V. Building and equipment requirements

It was assumed that all the new buildings needed for the expanded enrolment would house the new lower-level secondary schools proposed in the plan. Thus an estimate was made of the capital outlay necessary for such a school, the construction details and equipment of which are given in Tables 3 and 4. The unit cost of a single building was used as a basis for the calculation of the total number of buildings required for dealing with the enrolment expansion.

TABLE 4. Enumeration of school equipment

Equipment	Number required	Unit cost (NCr$)	Total cost (NCr$)
Desks and chairs	340	40.00	13 600.00
Chairs (loose)	280	11.00	3 080.00
Teachers' classroom desks	16	60.00	960.00
Library tables	10	50.00	500.00
Conference table	1	70.00	70.00
Typewriter tables	2	45.00	90.00
Office desk	1	115.00	115.00
Revolving chair	1	35.00	35.00
Plain cabinets	15	130.00	1 950.00
Cabinets with glass windows	4	130.00	520.00
Physical education equipment storage cabinet	1	100.00	100.00
Filing cabinet	1	450.00	450.00
Waiting-room furniture	1	100.00	100.00
Library bookcases	3	70.00	210.00
Library counter	1	80.00	80.00
Stove	1	300.00	300.00
Typewriter	2	800.00	1 600.00
Records file	2	40.00	80.00
Green wall blackboards	16	30.00	480.00
Wall charts	10	15.00	150.00
Globe	3	50.00	150.00
Wastepaper baskets	15	2.00	30.00
Equipment for audio-visual laboratory	1	5 000.00	5 000.00
Equipment for physical science, chemistry, and natural history laboratories	1	12 000.00	12 000.00
Equipment for agricultural courses and/or industrial arts	2	10 000.00	20 000.00
Equipment for commercial arts	1	12 000.00	12 000.00
Workshop benches			6 350.00
Total			80 000.00

NOTE Secondary education: 1st level (lower-level secondary)
Type of school: lower-level secondary
Anticipated enrolment: 400 pupils (per session)

Like most of the other figures included in the plan, capital outlays were decided on the basis of very crude data and simple methodologies. Thus, an appraisal of the actual situation of public school buildings used for secondary schools was made on the basis of information collected from the Secretariat of public works and from different departments of the Secretariat of education. This showed that, out of the 201 buildings used for housing public schools of middle-level education of all types, 176 were State-owned buildings and 25 rented or 'use-granted' buildings. The condition of State buildings was as follows:

In a satisfactory condition	61
Housed in primary-school buildings (therefore unsatisfactory)	80
Needed expansion	35
Total	176

From these data, two assumptions were made for estimating building needs. The first was that public schools were totally occupied at the present time. This view was supported by the evidence of intense shortage of facilities for public school enrolments. Thus an expansion in enrolment could only be provided through new buildings or new rooms in existing schools.

The second assumption was that new accommodation would have to be provided for *ginásios* that were using primary-school buildings. The number of such schools amounted to 80, as already noted. However, since some lower-level secondary schools using primary-school buildings were situated in small localities with small enrolments and did not need a new building, it was decided that not all lower-level secondary schools should be provided with new buildings.

The number of new schools to be built was then estimated: it included new buildings and also rebuilding of existing premises for the schools that would, according to the general policy, be changed into 'vocationally oriented lower-level secondary schools'.

Table 11 in the Appendix shows the capital outlay needed by all the schools on the basis of the above assumptions, though the final result was arrived at by a process of trial and error until capital outlay needs (new schools, transformations and adaptations) seemed to correspond to the expansion in enrolments.

VI. Concluding remarks

In many planning situations, the estimate of the cost of an educational project expressed in human resources (teachers) and financial and physical resources is followed by an assessment of the feasibility of the project by comparing its cost with an estimate of available resources. In the case of the Rio Grande do Sul secondary-education project, it was not necessary to proceed in this way, since,

on the one hand, the estimate of teacher needs showed that the capacity of teacher-training centres was sufficient to meet the staffing targets, and, on the other, the project was defined in such a way that its recurrent cost should be exactly equal to the State education budget, taking into account the annual 2 per cent increase in the proportion of the total budget allocated to education, as agreed with the federal government. The capital cost was to be financed by the foreign aid agency.

In addition, it was decided that at least 40 per cent of the annual increase should be made available for secondary education; such a decision made it possible to calculate the total State budget and the share of secondary education in it as well as the size of the development project involved. Table 5 shows how these calculations were made.

TABLE 5. Estimation of resources available to education, 1968–71 (in NCr$ thousands)

Year	Total state budget (A)	Expenditures on education (B)	% B/A	Middle education share (C)	% C/B
1968	583 966	119 129	20.4	47 252	39.6
1969	617 252	138 264	22.4	55 305	40.0
1970	652 436	159 194	24.4	63 678	40.0
1971	689 625	182 061	26.4	72 824	40.4

When we turn from the estimate of the costs of the project to the question of its actual implementation, we must remember that the State Plan of Education was finished only in late December 1967. Thus, only the 1969 budget could be devised to implement the plan. In addition, the external funds required for the implementation of the project have not yet been granted, since the bilateral agreement between the federal government and USAID has not been signed so far. Lastly, the inadequacy of the administrative structure in the Secretariat of education of Rio Grande do Sul is in itself an obstacle to the appraisal of the progress made in carrying out the secondary-school project. Thus no conclusions can yet be drawn about the implementation of the project.

One aspect of the Brazilian experience which deserves comment in this final section is the planning techniques used. It must be admitted that many weaknesses exist in this example of cost analysis. The case study has already emphasized the scarcity of data and their inadequacy, as well as some of the unsatisfactory techniques used, particularly in the estimate of teacher needs and the costing of the project. The three methods used in calculating teacher needs under-estimate the teacher-training effort required by the secondary project. This is due to the fact that the assumptions made were either totally arbitrary, for example, concerning the number of pupils per class, or else more related to an ideal, rather than real, situation, for instance in the estimate of teacher-hours per week.

Similarly, there are a number of weaknesses in the costing of the project. To give but a few examples, personnel salary estimates are not based on an analysis of the distribution of teachers and personnel by level on the salary scale, and by sex, age, etc. Estimates of other recurrent expenditures are not related to any

thorough study of their trends in relation to the type of school (especially with regard to the introduction of the new vocationally-oriented *ginásios*); capital costs and recurrent costs are not calculated by taking into account expected price increases.

Several other criticisms can be made of the techniques used by the Brazilian State, and this raises the whole question of the usefulness of such a case study on the use of cost analysis in educational planning. In this respect, there are two main reasons for examining the Brazilian experience in the framework of the IIEP project:

1. It provides a good example of the methods used to estimate the cost of a specific project in a situation where only very primitive data are available, and experience in planning is very limited.
2. It gives an interesting instance of a case of co-ordination of planning responsibilities at federal and State levels. It should be noted in this respect that the project was of sufficient magnitude to have a marked impact on the total educational plan for the State.

TABLE 1. Lower-secondary level—enrolments by type of study, 1964–76 (in thousands of pupils)

Year	Total enrolments	Grade 6[1]		Secondary[2]		Teacher trg[2]		Agriculture[2]		Industrial[2]		Commercial[2]		Ginásio orientado[3]	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1964	152	4.0	2.6	119.0	78.2	7	4.6	2.5	1.6	6.0	3.9	13	9.4	—	—
1965	168	4.0	3.0	132.0	77.2	8	5.3	2.2	1.3	6.0	4.1	16	8.5	—	—
1966	176	5.0	2.8	137.0	77.8	9	5.1	2.5	1.3	7.0	4.0	15	8.6	—	—
1967	188	6.5	3.5	139.0	73.9	9	4.8	2.4	1.3	7.0	3.7	15	8.0	9.0	4.8
1968	208	7.0	3.3	143.0	68.7	10	4.8	2.5	1.2	8.0	3.8	16	7.7	21.5	10.5
1969	229	8.0	3.5	139.7	61.0	9	3.9	2.5	1.1	7.0	3.1	16	7.0	46.8	20.4
1970	252	10.0	4.0	124.3	49.3	8	3.2	2.0	0.8	6.5	2.6	15	6.0	86.2	34.1
1971	277	12.0	4.3	107.4	38.8	7	2.5	1.5	0.5	4.5	1.6	14	5.1	130.6	47.2
1972	304	14.0	4.6	96.6	31.2	6	2.0	0.9	0.3	2.2	0.7	13	4.3	171.3	56.9
1973	333	18.0	5.4	86.3	25.9	5	1.5	0.5	0.2	1.5	0.5	12	3.6	209.7	62.9
1974	364	21.0	5.8	77.0	21.2	4	1.1	0.3	0.1	1.0	0.3	10	2.7	250.7	68.8
1975	396	25.0	6.3	69.7	17.6	3	0.8	—	0.0	—	0.0	8	2.0	290.3	73.3
1976	430	30.0	7.0	60.0	14.0	3	0.7	—	0.0	—	0.0	6	1.4	331.0	76.9

1. 1964, actual enrolments; 1965 onwards, estimated figures.
2. 1964-67, actual figures.
3. These figures show the gradual transformation of the traditional ginásio sectors into the new ginásio orientado para o trabalho (comprehensive).

SOURCE Divisão de Estatisticas Educacionais da S.E.C.

TABLE 2. Upper-secondary level—total enrolments by type of study, 1964–76 (thousands of pupils)

Year	Total	Academic		Teacher training		Agriculture		Industrial		Commercial	
		No.	%	No.	%	No.	%	No.	%	No.	%
1964	47	18.2	38.8	13.8	29.4	0.9	1.9	0.9	1.9	13.0	27.7
1965	53	21.4	40.0	14.4	26.9	0.7	1.3	1.6	3.0	15.3	28.6
1966	59	22.8	38.8	16.8	28.7	0.8	1.3	1.9	3.2	16.4	28.0
1967	65	27.4	41.8	17.0	25.9	1.4	2.1	1.6	2.4	18.0	27.5
1968	70	29.4	42.0	17.9	25.6	1.7	2.4	2.0	2.9	19.0	27.1
1969	77	31.9	41.4	19.5	25.3	2.1	2.7	2.6	3.4	20.9	27.2
1970	84	34.4	41.0	21.1	25.1	2.5	3.0	3.3	3.9	22.7	27.0
1971	92	37.5	40.8	22.8	24.8	3.1	3.4	4.2	4.6	24.4	26.5
1972	102	41.5	40.7	24.6	24.1	3.8	3.7	5.4	5.3	26.7	26.2
1973	114	46.3	40.6	26.4	23.1	4.7	4.1	6.9	6.1	29.7	26.1
1974	129	52.3	40.5	28.3	22.0	5.8	4.5	8.9	6.9	33.7	26.1
1975	145	58.6	40.4	30.2	20.9	7.1	4.9	11.4	7.8	37.7	26.0
1976	163	65.7	40.3	32.3	19.8	8.8	5.4	14.6	9.0	41.6	25.5

NOTE From 1964 to 1967, actual figures. The distribution by type of studies from 1967 onwards has been estimated:
(a) industrial and normal education; according to estimates of manpower requirements;
(b) agricultural education is a projection of 1962-67 trends;
(c) academic and commercial education: the difference between estimated total enrolments and previous estimations (a and b).

SOURCE As for Table 1.

TABLE 3. Projected enrolments by level and type of education, lower and upper secondary, 1964–76

Year	Type[1]	Grade 6[2]		Lower-level secondary (ginásio)[2]		Grade 6 plus ginásio: Total	Upper-level secondary (colégio)[2]		Grade 6 plus ginásio plus colégio	
		Numbers	Total	Numbers	Total		Numbers	Total	Numbers	Total
1964	PU	3 400	4 000	66 400	145 747	149 747	21 581	46 903	91 381	196 650
	PR	600		79 347			25 322		105 269	
1965	PU	3 400	4 000	79 250	163 185	167 185	25 985	53 447	108 635	220 632
	PR	600		83 935			27 462		111 997	
1966	PU	4 300	5 000	86 125	169 311	174 311	28 462	58 818	118 887	233 129
	PR	700		83 186			30 356		114 242	
1967	PU	5 600	6 500	94 980	181 444	187 944	31 267	65 394	131 847	253 338
	PR	900		86 464			34 127		121 491	
1968	PU	6 000	7 000	108 700	201 000	208 000	34 600	70 000	149 300	278 000
	PR	1 000		92 300			35 400		128 700	
1969	PU	6 700	8 000	126 000	221 000	229 000	39 300	77 000	172 000	306 000
	PR	1 300		95 000			37 700		134 000	
1970	PU	8 500	10 000	144 400	242 000	252 000	44 300	84 000	197 200	336 000
	PR	1 500		97 600			39 700		138 800	
1971	PU	10 300	12 000	165 200	265 000	277 000	50 000	92 000	225 500	369 000
	PR	1 700		99 800			42 000		143 500	
1972	PU	11 900	14 000	188 500	290 000	304 000	57 100	102 000	257 500	406 000
	PR	2 100		101 500			44 900		148 500	
1973	PU	15 500	18 000	212 400	315 000	333 000	65 700	114 000	293 600	447 000
	PR	2 500		102 600			48 300		153 400	
1974	PU	18 000	21 000	239 800	343 000	364 000	76 300	129 000	334 100	493 000
	PR	3 000		103 200			52 700		158 900	
1975	PU	21 700	25 000	267 600	371 000	396 000	88 100	145 000	377 400	541 000
	PR	3 300		103 400			56 900		163 600	
1976	PU	26 400	30 000	296 400	400 000	430 000	101 600	163 000	424 400	593 000
	PR	3 600		103 600			61 400		168 600	

1. PU: public; PR: private. 2. Actual figures for 1964, remainder estimated. 3. Actual figures from 1964 to 1967, remainder estimated.

TABLE 4. Teacher requirements according to various methods of estimation

	1968	1969	1970	1971
First method[1]				
Ginásio (1:14)	7 951	9 155	10 544	12 210
Colégio (1:7)	5 351	6 285	7 428	8 857
Second method[2]				
Ginásio				
Academic	3 810	3 633	2 988	2 155
Normal	352	300	246	212
Industrial	506	506	409	292
Agricultural	142	126	113	74
Commercial	383	346	326	306
Orientado para o trabalho	1 149	2 531	4 565	6 981
Total	6 342	7 442	8 647	10 020
Colégio				
Academic	1 116	1 276	1 388	1 588
Normal	442	482	520	560
Industrial	149	192	229	293
Agricultural	154	190	224	280
Commercial	225	257	291	322
Comprehensive	—	—	64	106
Total	2 086	2 397	2 716	3 049
Grand total by second method	8 428	9 837	11 363	13 069
Third method[3]				
Ginásio orientado para o trabalho	713	1 582	2 853	4 362

1. By student/teacher ratios.
2. By number of classes and weekly hours.
3. By 'model' schools.

TABLE 5. Average unit cost of teachers and technical and administrative staff for secondary education, 1968–71 (NCr$)

Year	Teacher[1]	Director[2]	Assistant director[3]	Counsellor[4]	Supervisor[4]	Administrative staff
1968	3 826.56	5 572.56	4 714.46	—	—	2 552.66
1969	4 598.87	6 687.07	5 657.35	6 875.76	6 875.76	3 063.19
1970	5 288.70	7 690.13	6 505.95	7 907.12	7 907.12	3 522.66
1971	6 082.00	8 843.65	7 481.84	9 093.18	9 093.18	4 051.05

1. Based on the present average salary for teachers.
2. Arithmetic mean of salary supplement levels, 5, 6, 7 and 8, plus annual average teacher's salary (column 1).
3. Arithmetic mean of salary supplement levels 3, 4 and 5, plus annual average teacher's salary.
4. 1969-71: Salary level 15 + three increases of 5 per cent.

NOTE Salaries of both teachers and technical and administrative staff were assumed to increase by 20 per cent in 1968 and 1969 and by 15 per cent in 1970 and 1971.

TABLE 6. Expenditures on education—Rio Grande do Sul State budget (in NCr$)

Year	Elementary	Middle	Total	Budget	% of budget for education
1959	1 411 724	509 046	2 664 795	13 832 313	19 %
1960	2 728 907	1 053 502	5 289 078	22 550 732	23 %
1961	3 939 049	1 785 900	8 757 674	34 118 539	25 %
1962	5 867 207	2 525 097	11 945 019	47 293 778	25 %
1963	10 939 342	3 335 497	21 808 866	90 660 788	24 %
1964	25 872 604	13 403 805	44 708 119	156 052 241	28 %
1965	51 700 756	28 254 966	86 035 984	307 114 553	28 %
1966	74 454 652	36 433 877	108 402 392	432 450 096	25 %
1967[1]	74 816 203	50 431 026	148 890 198	576 562 891	25 %

1. Data from the budget proposal.

TABLE 7. Secretary of education and culture: expenditure, 1965

Item	Administration	Primary education	Middle-level education	Culture	Physical education	Grants for students	Miscell.	Total
Recurrent expenditure								
Personnel	880 250.62	45 266 298.10	24 478 384.58	237 143.55	718 467.21	—	481 106.20	72 061 650.26
Family allowances	4 800.00	92 000.00	21 955.50	1 310.00	1 500.00	—	260.00	121 825.50
Materials (consumer)	43 657.34	107 577.41	660 326.02	7 348.41	202 583.12	—	22 673.16	1 044 165.46
Services	68 142.84	1 902 948.05	212 255.63	37 728.67	18 878.62	—	11 573.59	2 251 527.40
Miscellaneous	738.68	2 216.89	1 626.00	80.24	—	—	312.50	4 974.31
Transfers[1]	—	4 135 687.58	2 580 351.47	11 165.00	—	519 220.60	17 763.00	7 264 187.65
Total recurrent	997 589.48	51 506 728.03	27 954 899.20	294 775.87	941 428.95	519 220.60	533 688.45	82 748 330.58
Capital expenditure								
Public works	—	—	—	—	—	—	—	—
Equipment and installations	—	—	—	—	—	—	—	—
Durable goods	—	50 000.00	124 999.68	—	—	—	—	174 999.68
Transfers	—	—	—	—	—	—	—	—
Total capital	—	50 000.00	124 999.68	—	—	—	—	174 999.68
Total expenditure	997 589.48	51 556 728.03	28 079 898.88	294 775.87	941 428.95	519 220.60	533 688.45	82 923 330.26
Total expenditure of State government								307 114 553.00

1. Includes subventions to educational institutions and grants for students; excludes family allowances.

TABLE 8. Secretary of education and culture: expenditure, 1966

Item	Administration	Primary education	Middle-level education	Culture	Physical education	Grants for students	Miscell.	Total
Recurrent expenditure								
Personnel	916 287.83	64 520 286.63	33 125 957.08	264 212.10	1 177 617.18	—	783 723.25	100 788 084.07
Family allowances	6 500.00	159 647.80	48 607.98	1 600.00	2 000.00	—	270.00	218 625.78
Materials (consumer)	78 183.39	96 456.23	836 542.17	2 403.01	189 275.84	—	13 133.17	1 215 993.81
Services	96 981.85	2 464 131.11	330 024.39	34 582.14	31 213.58	—	12 509.01	2 969 442.08
Miscellaneous	968.67	1 451.18	541.49	—	80.00	—	333.99	3 375.33
Transfers	—	—	—	—	—	572 543.25	—	572 543.25
Total recurrent	1 098 921.74	67 641 972.95	34 341 673.11	302 797.25	1 400 186.60	572 543.25	809 969.42	105 768 064.32
Capital expenditure								
Public works	—	26 460.00	—	—	—	—	—	26 460.00
Equipment and installations	—	—	—	—	—	—	—	—
Durable goods	—	—	143 132.82	—	—	—	—	143 132.82
Transfers	—	7 141 370.74	1 936 207.98	210 550.00	—	—	—	9 288 128.72
Total capital	—	7 167 830.74	2 079 340.80	210 550.00	—	—	—	9 457 721.54
Total expenditure	1 098 921.74	74 409 803.69	36 421 013.91	513 347.25	1 400 186.60	572 543.25	809 969.42	115 225 785.86
Total expenditure of State government								432 450 095.80

TABLE 9. Secretary of education and culture; budget, 1967

Item	Administration	Primary education	Middle-level education	Culture	Physical education	Grants for students	Miscell.	Total
Recurrent expenditure								
Personnel	1 549 500.00	70 289 471.25	59 753 943.93	359 517.82	277 250.00	—	2 075 032.00	134 214 715.00
Family allowances	10 000.00	160 000.00	60 000.00	2 00.00	1 500.00	—	2 710.00	236 210.00
Materials (consumer)	87 700.00	171 250.00	1 419 900.00	11 860.00	20 800.00	—	397 230.00	2 108 740.00
Services	86 920.00	2 211 200.00	478 700.00	49 300.00	19 080.00	—	215 496 00	3 060 696.00
Transfers[1]	4 200.00	3 453 879.75	347 049.07	216 100.18	1 350.00	3 175 497.00	4 590 582.00	11 788 658.00
Total recurrent	1 648 320.00	76 285 801.00	62 059 593.00	638 778.00	319 980.00	3 175 497.00	7 281 050.00	151 409 019.00
Capital expenditure								
Public works	—	40 000.00	40 000.00	—	—	—	—	80 000.00
Equipment and installations	2 000.00	1 000.00	360 000.00	2 100.00	1 500.00	—	20 700.00	387 300.00
Durable goods	10 800.00	182 000.00	598 000.00	11 400.00	11 500.00	—	52 980.00	866 680.00
Transfers	—	—	45 000.00	—	—	—	360 000.00	405 000.00
Total capital	12 800.00	223 000.00	1 043 000.00	13 500.00	13 000.00	—	433 680.00	1 738 980.00
Total expenditure	1 661 120.00	76 508 801.00	63 102 593.00	652 278.00	332 980.00	3 175 497.00	7 714 730.00	153 147 999.00
Total expenditure of State government								552 475 300.00

1. Includes subventions to educational institutions and grants for students; excludes family allowances.

TABLE 10. State expenditure on middle-level education: recurrent expenditure at 1967 prices (in NCr$ thousands)

Item	1968[1]	1969[2]	1970	1971
Personnel	42 088.00	49 406.00	55 778.00	61 724.00
Material	1 871.00	2 700.00	3 800.00	5 300.00
Transfers[3]	2 506.00	3 200.00	4 100.00	5 800.00
Total	46 465.00	55 306.00	63 678.00	72 824.00

1. The allocation by items is that used in the State budget proposal for 1968.
2. From 1969 onwards expenditure on personnel reflects improvements in salaries, and that on materials reflects increased supplies to schools.
3. Includes grants for students.

TABLE 11. State expenditure on middle-level education: capital expenditure 1968–71 (in NCr$ thousands)

Item	1968/69	1969/70	1970/71	Total
Construction	12 225.5	13 159.0	13 180.5	38 565.0
Equipment	4 900.0	5 290.0	5 330.0	15 520.0
Total	17 125.5	18.449.0	18 510.5	54 085.0

India *17*

The use of cost-benefit analysis as a guide to resource allocation in education

prepared by Maureen Woodhall

This study was prepared by Maureen Woodhall, IIEP. Philip H. Coombs served as principal adviser to the study.

Introduction

This case study is concerned with three applications of cost-benefit analysis to education in India. There have been a number of attempts to calculate rates of return to education in India, based on alternative estimates of both the costs and economic benefits of different types of education.[1] The purpose of calculating these rates of return was slightly different in each case, but fundamentally all were concerned with the problem of efficient allocation of resources. This case study will examine the methodological differences between the various estimates of rates of return and the conclusions drawn by the authors, in order to suggest what are the practical implications of such cost-benefit studies for educational planning in India and in other countries. One reservation must be made at the outset: all these studies relate only to urban India, as no data were available on earnings in rural India. The implications of this for policy will be discussed below.

The study by Blaug *et al.* was primarily concerned with the problem of imbalance between the education system and demand for educated manpower, which has resulted in a serious problem of educated unemployment. It looks at the causes of unemployment among graduates and matriculates and attempts to explain it by way of analysis of both the demand for and supply of educated manpower, which includes analyses of trends in unemployment and wage rates, the operation of the labour market, and estimates of the social and private rate of return to education.[2] The authors estimate that even with the most narrow definitions of 'unemployment' there were at least half a million totally unemployed graduates and matriculates in India in 1967. Their study applies the tools of cost-benefit analysis to this problem of surplus manpower, to discover why such surpluses persist despite the growth of the economy, and to discover whether, in the light of such a surplus, education is still 'a paying proposition either to the individual or to the society'.

This case study does not attempt to summarize the whole work, but looks only at the use made by the authors of cost-benefit analysis.

The rate of return on educational investment is treated as 'a convenient statistic describing the relationship between the earnings of educated people and the costs of acquiring education', in the belief that 'this relationship ought to be a key

1. M. Blaug, P. R. G. Layard and M. Woodhall, *The Causes of Graduate Unemployment in India*, London, Allen Lane, The Penguin Press, 1969; A. C. Harberger, 'Investment in men versus investment in machines: The case of India' in *Education and Economic Development*, ed. C. A. Anderson and M. H. Bowman, Chicago, Aldine Publishing Co., 1965; A. M. Nalla Gounden, 'Investment in Education in India', *Journal of Human Resources*, summer, 1967, pp. 347–58.

2. The problem of graduate unemployment in India has been discussed, although not rigorously analysed, by other authors. See, for instance, V. K. R. V. Rao, 'Educational output in relation to employment opportunities, with special reference to India', in IIEP, *Manpower Aspects of Educational Planning: Problems for the Future*, Paris, Unesco:IIEP, 1968.

element in any diagnosis of the educational situation of a country, rich or poor'.[1] The authors specifically state that 'at no stage in the argument will we assume that mere comparison of social rates of return can by itself constitute a sufficient basis for educational planning', but argue that rate-of-return analysis can help to explain the persistence of educated unemployment in India, and also serve as a guide to the more efficient allocation of resources in the future.

The other two studies are both concerned only with this latter issue of resource allocation, and their prime objective is to throw light on the problem of the proper allocation of resources to education as a whole, although they also consider allocation between different levels of education. Harberger, as the title of his study suggests, is concerned with the relative profitability of investment in human capital and physical capital. Although he does produce estimates of the social rate of return to physical capital and to education that suggest that 'the economic return to investment in physical capital is higher (and may be substantially higher) than the economic rate of return to secondary and higher education',[2] Harberger does not draw direct conclusions about resource allocation; instead, he states 'I prefer to regard this study as suggesting future research rather than as indicating particular alterations of existing investment patterns'.[3] But in principle the purpose of this type of cost-benefit analysis is to act as a guide to a socially optimum investment policy.

Similarly, Nalla Gounden is concerned first with the question 'What should be the total amount of financial support for education at all levels to ensure such goals as economic growth, social cohesion and national security? and secondly, 'How should this total be distributed among different levels and types of education?'[4]

Before turning to a detailed examination of the three studies, we should perhaps spend a moment on the theoretical framework of cost-benefit analysis. This is not the place for a thorough review of the arguments for and against cost-benefit analysis, as this has been attempted elsewhere.[5] However, a short summary of the assumptions of cost-benefit analysis may be useful.

All examples of cost-benefit analysis attempt to measure the economic benefits of education and relate these to costs. Because of difficulties of defining and measuring indirect economic benefits, most rate-of-return calculations concentrate on the measurement of direct benefits, and these three Indian examples are no exception. Direct benefits are measured in terms of the higher earnings of educated people, on the assumption that these earnings differentials reflect higher productivity. This measure of benefit is then directly compared with the private or social costs of education, by means of the internal rate of return, which is the discount rate which equates the present value of the sum of future benefits to the present

1. M. Blaug, P. R. G. Layard and M. Woodhall, op. cit., Ch. 1.
2. A. C. Harberger, op. cit., p. 11.
3. Ibid, p. 33.
4. A. M. Nalla Gounden, op. cit., p. 347.
5. See, for example a booklet by the author in the IIEP 'Fundamentals of Educational Planning' Series: *Cost-Benefit Analysis in Educational Planning*, Paris, 1970.

value of costs. The private or social rate of return to education, computed in this way, is assumed to measure the profitability of investment in education, either for the individual, or for society.

These assumptions are obviously open to a number of objections. All the authors of the studies under review are aware of such objections. Both Harberger and Nalla Gounden point out that education produces non-monetary returns which are not yet capable of quantification but none the less must influence decisions about resource allocation. For instance, Nalla Gounden lists 'greater individual employment choice', 'protection against the vicissitudes of technical change' and 'psychological benefits' as examples of private non-monetary returns and 'improved housing and employment' as one of the social returns that are not taken into account by rate-of-return calculations. Similarly, both authors draw attention to the factors other than education that determine earnings differentials, so that they do not fall into the trap of assuming that all earnings differentials represent returns to education. Blaug *et al.* list five common objections to rate-of-return analysis and attempt either to meet the objection or to show how it will affect policy conclusions. These objections are:

1. The earnings differentials which we observe to be associated with different amounts and types of education cannot be solely attributed to differences in education: native ability, endowed intelligence, achievement drive, social class and ethnic origins, education of parents, on-the-job training, all have some independent effect on earnings, although perhaps not in any simple additive way.
2. Education produces non-pecuniary and non-economic returns which are not included in the measurement of rates of return.
3. The rate-of-return measures only the direct benefits of education to individuals, ignoring altogether the indirect or external, or neighbourhood benefits, the spillovers of education, as they are sometimes called, which cause the marginal social product of educated labour to exceed the marginal private product. Three of these economic spillovers which seem particularly relevant for India are: (i) the fact that general literacy reduces the costs of spreading information; (ii) the tendency of the diffusion of education to reduce birth-rates and (iii) the fact that education provides a convenient selective device for promoting the able rather than those with suitable family connexions.
4. Earnings differentials by educational attainments do not exactly measure the relative marginal productivities of educated labour in any poor country, and certainly not in India.
5. Rates of return, as calculated, are based upon present demand and supply conditions and 'in countries where profound structural changes in the economy have recently taken place and will continue to take place, present market conditions can give only limited guidance to future returns'.

Some of these objections can be taken into account when calculating rates of return. For example, two of the studies under review do not use the whole of the earnings differentials associated with education as a measure of the benefits attributable to education, but reduce these differentials by a constant factor to

allow for the influence of ability and other factors or earnings. However, the fact remains that some of these objections do raise serious difficulties of interpretation of rates of return. For example, the neglect of non-economic returns and indirect benefits mean that rates of return provide only a minimum estimate of the effects of investing in education; decisions on resource allocation must somehow take account of this. Similarly, the fact that rates of return based on cross-section data on earnings reflect *past* investment decisions and *present* market conditions, means that they do not necessarily provide an accurate measure of the *future* profitability of investment in education, particularly if non-marginal changes are contemplated. For cost-benefit analysis is essentially a tool of marginal analysis, which assumes that the current balance between supply and demand will be maintained. If this balance is totally changed, for instance by a massive expansion of education or of employment opportunities, then the future rate of return to education will differ substantially from that observed today.

Some of these problems will be discussed at the end of this case study, in the sections on the policy implications of rate-of-return analysis of Indian education. For the moment, it is enough to observe that such objections explain why cost-benefit analysis cannot, *by itself*, serve as a guide to educational planning. This case-study is concerned with the question of whether cost-benefit analysis can nevertheless offer some helpful lessons to planners in India, or elsewhere.

I. Estimates of the private and social rates of return to education in India

A. Estimation of benefits

All the studies use age-earnings profiles of workers with different levels of education to estimate the direct economic returns to education in terms of the extra earning capacity of educated workers, on the assumption that earnings reflect productivity.

Nalla Gounden and Blaug *et al.* use actual survey data of the age-specific earnings of educated workers. These data are derived from (i) a random sample survey of 4,650 males in urban areas, collected in the 'Urban income and saving survey' of 1960–61;[1] and (ii) surveys of about 4,000 engineers, carried out by the Council of Scientific and Industrial Research between 1959 and 1966.[2] In addition, Blaug

1. National Council of Applied Economic Research, '*Urban Income and Saving*', New Delhi, 1962.
2. '*Technical Manpower*', (C.S.I.R.), 1961–67.

et al. use surveys of random samples of about 20,000 workers in factories in the fertilizer, machine tools, heavy electrical and consumer product industries.[1]

Harberger used data on the average incomes of workers in different educational categories, collected from a survey of 5,885 male workers in Hyderabad in 1956; unfortunately the earnings data were not classified by age as well as by education, so that Harberger was forced to derive age-earnings profiles from the data on average earnings, on the basis of specific assumptions, for instance about the age of peak earnings and the relative steepness of the profiles. His aim was to produce an over- rather than an under-estimate of the rate of return to education, so that he 'consciously tried to bias the assumptions in the direction that will produce high estimated rates of return'.[2] He assumed, for instance, that peak earnings occur relatively early in life (between 30 and 40) and that the age-earnings profiles were not very steep, that is, that the ratio of peak to average earnings was fairly low (between 1.1 and 1.2). This latter assumption was a deliberate attempt to produce a high estimate for the rate of return, since 'the steeper an age-earnings profile, the greater the fraction of total income received late in life and hence the smaller the present value of a given total income' (and thus the lower the internal rate of return).[3] Harberger stated that he believed his estimates of age-earnings profiles 'understated the relative steepening of the profile as one moves up the educational ladder'. In fact, the evidence from the other studies supports this belief. The consequence of this on the rate-of-return estimates is discussed below. The actual age-earnings profiles suggest that workers reach their peak earning capacity between the ages of 40 and 57 and that the profiles are fairly steep, that is that the ratio of peak to average earnings is about 1.5. Typical age-earnings profiles for India are shown in Figure 1, which is based on the data from the Urban Income Survey.

Figure 1 shows that earnings are clearly related to education in India: average lifetime earnings rise with every additional level of education; in addition, average earnings increase with age up to a peak which usually occurs between 40 and 55, and the earnings profiles are steeper for each successive stage of education. Altogether, age-earnings profiles were calculated for eight levels of education (illiterates, primary-school leavers, middle-school leavers, and those holding matriculation, intermediate (that is between matriculation and a first degree), bachelor's degree, diploma, or master's degree) and various specific types of education, such as arts and science degrees, engineering degrees and engineering diplomas.

These age-education-earnings profiles were then used to calculate the additional lifetime income associated with each type of education. Harberger and Nalla Gounden calculated only pre-tax differentials, but Blaug *et al.* calculated both pre-tax differentials (for an estimate of *social* returns) and after-tax differentials

1. D. Owens *et al.*, *Educated Manpower for India's Industrial Development*, London, Allen Lane, The Penguin Press, 1969.
2. A. C. Harberger, op. cit., p. 23.
3. Ibid, p. 23.

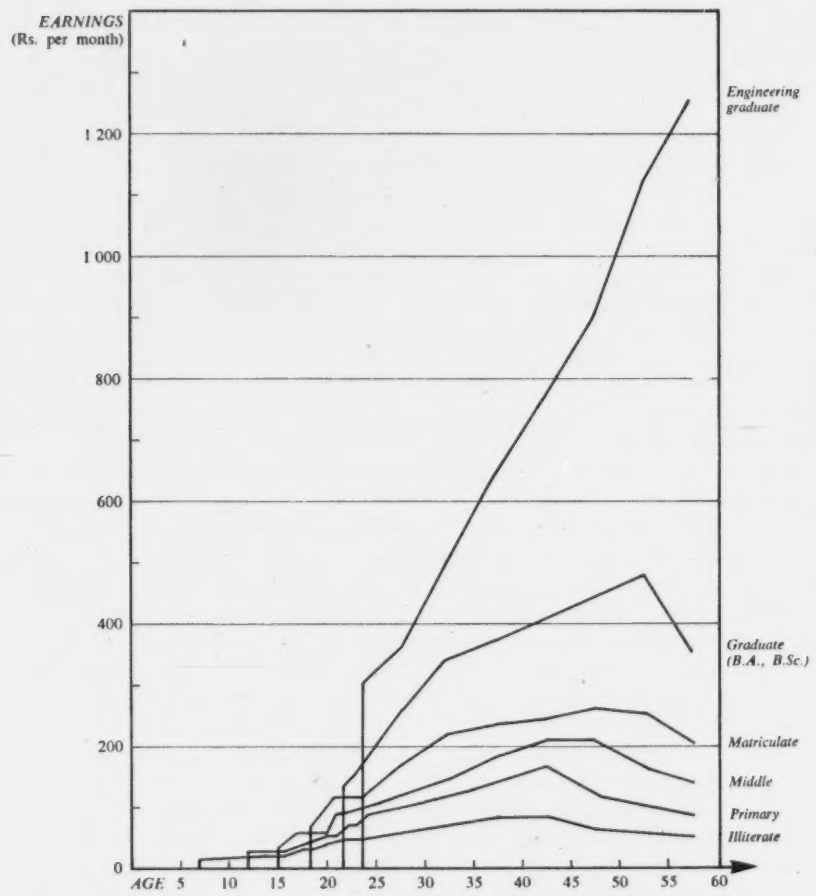


FIGURE 1. *Age-education-earnings profiles from the urban income survey, 1960.*

(for the *private* return calculation). A number of adjustments were then made to convert these simple earnings differentials to estimates of the direct returns to education.

1. *Adjustment for unemployment*

Blaug *et al* used information on the incidence of unemployment among graduates and matriculates to estimate expected lifetime earnings. The age-specific earnings of graduates and matriculates were multiplied by the observed proportions of graduates or matriculates who were in employment.[1] Nalla Gounden made no

1. These data were obtained from various employment surveys, mainly: The 1961 '*National*

adjustment for unemployment, although recognizing that it raised a problem; Harberger assumed that 6 per cent of all primary-school leavers were unemployed, but that all graduates and secondary-school leavers were employed. In fact, employment surveys shows that the incidence of unemployment is greater among graduates and matriculates than among primary-school leavers. Unemployment is concentrated mainly in the early years of a working life, in India, so that if total unemployment is expressed in terms of an 'average waiting period' before employment the surveys show that graduates wait, on average, six months before obtaining their first job and matriculates 1.4 years.

The measurement of benefits in terms of present age-specific probabilities of employment is open to the same objection as the use of present earnings differentials: these provide a correct estimate of expected future benefits only if the present pattern of earnings and unemployment is maintained in the future. However, some allowance for unemployment is clearly required in a rate-of-return calculation, and the use of current age-specific unemployment rates seemed to the authors the most satisfactory solution.

2. *Adjustment for other factors determining earnings*

All the authors recognized that earnings differentials reflect many factors besides education, but no information is available for India to show the influence of education alone. Therefore the only way to deal with this problem is to make an arbitrary assumption about the proportion of extra earnings attributable to education. Harberger took the whole of the earnings differentials associated with education as a measure of the 'returns to education', although recognizing that 'differences in natural abilities certainly explain part of the extra earnings of more highly educated groups'.[1] But this assumption is consistent with his objective to 'aim for an over-estimate' of the rate of return to education.

Nalla Gounden used only half the observed earnings differentials when calculating the returns to education. 'Our adjustment ratio of 0.5 is purely arbitrary; but treating the whole difference as the return to education would be equally arbitrary'.[2]

Blaug *et al.* discuss various hypotheses about the pure effect of education on income but in the absence of evidence conclude:

> 'Rather than committing ourselves to a definite view about the proportion of earnings differentials in India that are attributable to education, a proportion which we shall call α, we have made our calculations on the basis of three different assumptions, namely, that 50 per cent, 65 per cent and 100 per

Sample Survey', which collected information on the incidence of unemployment in urban and rural areas, and three studies of sample 'cohorts' of graduates and matriculates; Ministry of labour and employment (Directorate-general of employment and training), *'Report on the pattern of graduate employment'*, 1963; a *'Survey of the alumni of Delhi University'*, 1960; and Ministry of labour and employment (Directorate-general of employment and training), *'Employment of matriculates'*, 1961.

1. A. C. Harberger, op. cit., p. 29.
2. A. M. Nalla Gounden, op. cit., p. 350.

cent of the earnings differentials arise from that source. The reader can now take his choice, although in interpreting the results we shall in fact concentrate on the middle of the three assumptions as our own best estimate'.[1]

3. *Adjustment for wastage*

All the authors are concerned with the economic returns to *completing* a particular level of education, but in a country with high rates of drop-out and repeating the difficulty arises of how to deal with the earnings of workers who have started, but not completed, a particular level. The income data from the Urban Income Survey and from the four industry surveys refer only to workers who have completed a particular level of education. The Hyderabad survey, on the other hand, included those with 'some secondary education' or 'some under-graduate education'. Thus the average earnings calculated from these data reflect the earnings of drop-outs as well as completers. A survey of earnings in Bombay provides the only evidence for India of the effect on earning capacity of starting, but not completing, a course.[2] This survey suggests that the economic returns to drop-outs are very low. For example, the average monthly earnings of workers with 'some higher education, but no degree' were Rs. 306, which is only Rs. 10 more than the average earnings of matriculates, and Rs. 205 less than the average for graduates.

Since the earnings data used by Nalla Gounden and by Blaug *et al.* refer only to those who completed a given level, it was not necessary for them to make any adjustment on the benefit side of the calculation of rates of return, although Blaug *et al.* did make an adjustment on the cost side, which will be discussed below. Harberger's data, on the other hand, referred to both drop-outs and completers, so that he used the average earnings calculated for the sample to estimate the earnings of 'completers' by making an assumption about the average length of schooling of the workers in each category and by assuming that earnings rise steadily with each additional year's schooling.[3] These calculations were admittedly rough, but once again Harberger hoped that any bias in the estimates resulting from his adjustment would result in an *over-estimate* of returns.

1. M. Blaug, P. R. G. Layard and M. Woodhall, op. cit., Ch. 1.

2. D T. Lakdawala, V. N. Kothari, *et al.*, *Work, wages and well-being in an Indian metropolis: economic survey of Bombay City*, Bombay, University of Bombay Press, 1963.

3. For example, the survey showed that the average earnings of workers with 'some primary schooling' equalled Rs. 65.04 a month. It takes eight years to complete primary education (including 'middle schooling', as the last three years of primary schooling are called in some states), but Harberger assumed that the average number of years' completed schooling for the sample was only four; the rate of increase of earnings associated with these four years of schooling was 10.5 per cent and the rate of increase associated with the next six years, estimated from the average earnings of those with secondary education, was 12.4 per cent. Therefore Harberger assumed that a rough average of these two rates of increase—that is, 11.5 per cent—represented the rate of increase in earnings associated with the final four years of primary schooling, and accordingly estimated the average earnings of primary-school 'completers' as Rs. 100.49 a month ($= 65.04 \times (1.115)^4$).

4. *Adjustment for mortality and reduced labour force participation*

Since mortality rates are higher in developing than in developed countries, it is reasonable to take some account of losses to the labour force due to sickness or mortality when estimating the benefits of education. Harberger assumed that from the age of 40 onwards a certain fraction of workers withdraws each year from the labour force due to ill-health or death; the fractions he chose averaged about 2 per cent a year for primary-school leavers and 1 per cent for university graduates. Nalla Gounden mentions differences in survival rates as one factor which may influence economic returns, but did not make any allowance for the factor. Blaug *et al.* looked at some evidence of mortality rates in India and concluded that since mortality is lower among educated people than among illiterates the effect of adjusting the earnings streams of educated workers to take account of mortality would be very small and would have an almost negligible effect on estimates of the rate of return.

5. *Adjustment for growth in incomes*

One of the problems of using cross-section data on earnings as a measure of benefits is that they do not reflect the fact that future incomes are likely to rise as a result of economic growth, so that lifetime incomes will be higher than those calculated from current cross-section data. Nalla Gounden emphasized this problem, but did not adjust the earnings to take account of it; nor did Harberger make any adjustment for long-term growth of incomes. Blaug *et al.*, however, assumed that in the future the education-specific earnings of workers would rise by 2 per cent a year as a result of economic growth. This assumption is an arbitrary one, but the effect of their adjustment is such that the reader can substitute an alternative long-term rate of growth and see what effect this would have on the estimated rate of return.

6. *Adjustment for tax payments*

Both Harberger and Nalla Gourden were concerned only with the social rate of return to education and so needed only pre-tax earnings differentials. Blaug *et al.* also calculated private rates of return, based on after-tax earnings. For this calculation they used the standard income tax rates applicable in 1966 and subtracted the tax paid by a married man with two children from pre-tax earnings in order to calculate post-tax earnings differentials. Obviously the actual post-tax returns received by different individuals depend on their particular circumstances, but this calculation is sufficient to illustrate the effects of taxation on earnings. The majority of workers in India do not pay direct taxes but taxation does affect the earnings of graduates and some matriculates, particularly over the age of 40. There are, therefore, six possible adjustments that could be made to observed

earnings differentials in order to convert these to estimates of the expected lifetime income attributable to education. The following table summarizes the adjustments that were made in each study under review.

TABLE 1. Adjustments to observed earnings differentials for calculation of economic returns to education

Rate-of-return estimates by:	Unemployment	Ability and other factors determining earnings	Wastage	Mortality and labour force participation	Long-term growth of incomes	Income tax
Blaug, Layard and Woodhall	×	× ($\alpha = 0.5, 0.65$ and 1.0)	× (adjustment to costs)	—	×	× (private)
Harberger	×	—	× (adjustment to earnings)	×	—	— (social only)
Nalla Gounden	—	× ($\alpha = 0.5$)	—	—	—	— (social only)

The fact that there is a number of possible adjustments that can be made to convert observed earnings differentials to 'expected' differentials in the light of such factors as unemployment and wastage, and the fact that none of the studies under review made the same adjustments, serve to emphasize that the estimation of the returns to education from earnings data necessarily involves a series of assumptions and therefore cannot result in a single estimate of direct economic benefits of education. The implications of this for rate-of-return analysis will be discussed later in the case study. We turn, now, to the other side of the rate-of-return calculations: the estimation of costs.

B. The estimation of costs

1. *The components of private and social costs*

Calculation of private and social rates of return demands separate estimates of:

(a) current expenditure on tuition
(b) annual value of buildings and equipment
(c) private or public expenditure on books
(d) earnings forgone by students
(e) private expenditure on fees

(a), (b), (c) = *social costs*
(c), (d), (e) = *private costs*

The authors of one study pointed out that 'few of the components of cost are readily available from Indian educational statistics but have to be obtained by a series of estimates and adjustments to existing figures'. This section shows how each individual cost component was estimated.

(a) Current expenditure on tuition

Blaug *et al.* and Nalla Gounden used official estimates of current expenditure per pupil as estimates of tuition costs, but Blaug *et al.* made separate estimates of unit costs by level of education as opposed to type of schools to allow for the fact that Indian educational statistics classify schools according to the top class of the school. Thus the official estimate of 'expenditure per secondary-school pupil' is actually based on per-pupil expenditure in schools which include middle- and primary-level pupils as well as secondary and therefore under-estimate the true costs of secondary-level education. The estimates of tuition costs used for the rate-of-return calculations were therefore based on independent estimation of expenditure at each level. Table 2 shows school enrolment in 1960/61 by level and by type of school.

TABLE 2. School enrolment by educational level and type of school, India, 1960/61 (millions)

	Type of school			
	Primary	Middle	Secondary	Total
Primary	26.6	6.7	0.3	33.6
Middle	—	3.9	3.6	7.5
Secondary	—	—	3.6	3.6
Total	26.6	10.6	7.5	44.7

SOURCE M. Blaug, P.R.G. Layard and M. Woodhall, op. cit., Ch. 8.

These figures were used to estimate per-pupil expenditure at each level on the assumption that expenditure per pupil was the same for all pupils at a given *level* of education regardless of the *type* of school. The new estimates of expenditure per pupil were derived from total expenditure figures and the enrolment data in Table 2, using the following equations:

(i) $26.6\ (\text{expenditure per pupil}_p) = \text{total expenditure}_p$

(ii) $6.7\ (\text{expenditure per pupil}_p) + 3.9\ (\text{expenditure per pupil}_m) = \text{total expenditure}_m$

(iii) $0.3\ (\text{expenditure per pupil}_p) + 3.6\ (\text{expenditure per pupil}_m) + 3.6\ (\text{expenditure per pupil}_s) = \text{total expenditure}_s$

where $\text{expenditure per pupil}_p$ = expenditure per pupil at primary level and $\text{total expenditure}_p$ = total expenditure of primary schools, and subscripts m and s indicate middle and secondary schools. Solving these three equations as simultaneous equations gave revised estimates of current expenditure per pupil at each educational level, as shown in Table 3, which also shows the official estimates

TABLE 3. Estimated current expenditure per pupil: by level of education and type of school (rupees per annum)

Educational level or type of school	Expenditure per pupil	
	By type of school (official estimate)	By level of education
Primary	28	28
Middle	41	62
Secondary	92	126

SOURCE M. Blaug, P.R.G. Layard, M. Woodhall, op. cit., Ch. 8.

of per-pupil expenditure used by Nalla Gounden. The revised estimates of expenditure per pupil at the middle and secondary levels are respectively 50 per cent and 36 per cent higher than the official estimates of expenditure by type of school.

A similar problem arose over the estimation of tuition costs at the university level. Nalla Gounden's calculations of the rate of return to a university degree simply used the total current expenditure of universities, divided by the number of students, as an estimate of expenditure per undergraduate, but Blaug *et al.* were concerned with differences in expenditure between undergraduate and post-graduate students, and between arts and science faculties, so this procedure was inadequate. A small pilot investigation of unit costs in 12 universities was available, which showed that, on average, in arts faculties, expenditure per student was twice as great at the post-graduate as at the undergraduate level, and in science faculties the ratio was 5:1.[1] Estimates of expenditure per student were therefore derived from the over-all average expenditure per student on the assumption that these ratios were applicable throughout India.

(b) Annual value of buildings and equipment

Both Nalla Gounden and Blaug *et al.* used the same method of estimating the annual value of educational capital, which was to estimate the annual rental value of buildings and equipment by amortizing the total money value of the capital over its assumed life. Their methods of valuing the existing stock of capital and their assumed interest rates for the amortization calculation were slightly different, but the same methodology was used to estimate the annual depreciation and interest, or imputed annual rent, for land, buildings and equipment. Blaug *et al.* assumed a 40-year life for buildings and a 6 per cent rate of interest (the bank rate in 1965), but they also carried out a sensitivity analysis by testing the effects of adapting a 25-year life, and a 12 per cent interest rate. The final estimates of unit costs of education were relatively insensitive to these changes, so that they concluded 'although our estimates of imputed rent are based on questionable

1. *Report of the Indian Education Commission*, New Delhi, 1966, p. 510.

assumptions our final results are relatively insensitive to changes in these assumptions'.

(c) Private expenditure on books and stationery

In India the purchase of books is a cost borne by the individual rather than by the school authorities and little information is available on average expenditure on books by educational level, so that both Nalla Gounden and Blaug *et al.* simply made assumptions on the basis of very limited evidence; for instance, a small sample survey of school pupils' expenditure on books.

(d) Earnings forgone by students

The earnings forgone by students and pupils represent one of the most important social and private costs of education. All three studies used age-earnings profiles as the source of data on forgone earnings. Blaug *et al.* made adjustments to the estimates of earnings forgone to allow for unemployment, in the same way as they later adjusted lifetime earnings when measuring the benefits of education.

The earnings data show no earnings for workers under the age of 12, and Nalla Gounden accordingly assumes that forgone earnings at the primary level are zero. However, when discussing the causes of school drop-out in India the Education Commission states 'after the age of 9 or 10 the child becomes an economic asset because he works at home or earns something outside'.[1] Blaug *et al.* therefore made estimates of the forgone earnings of primary-school children by extrapolating the age-earnings profiles before the age of 12 in the belief that in an underdeveloped country the time of even primary-school children does have some money value.

When measuring the opportunity cost of students' time, some allowance should be made for unemployment; for the existence of educated unemployment reduces the opportunity cost of students' time, just as it reduces the economic benefits of education. Some commentators have argued that the existence of unemployment means that the opportunity cost of students' time is zero, since a marginal addition to the labour force would automatically be unemployed. The same argument is sometimes applied to the benefit side of the calculation also: since any marginal addition to the labour force will be unemployed, the returns to education are zero. Blaug *et al.* argue that this argument is mistaken; that the existence of unemployment will mean that an increased supply of one graduate or matriculate will marginally lower graduate or matriculate wages, and increase employment, but that any measurement of the costs and benefits of education should take into account *average* levels of unemployment when estimating both earnings differentials and earnings forgone. Thus, their estimates of earnings forgone are multiplied by the age-specific proportions of graduate and matriculate employment, to give a measure of the true opportunity cost of students' time.

1. *Report of the Indian Education Committee*, op. cit., p. 159.

(e) Private expenditure on fees

This element of costs is relevant only for a calculation of the private costs of education. The proportion of students paying fees varies from 4 per cent in primary schools to 90 per cent in universities. Blaug *et al.* used the estimates of fee income made for the Indian Education Commission in 1966 and subtracted from the average fee paid per pupil or student the average scholarship received per student in order to arrive at the direct cost of study to the individual. Nalla Gounden included expenditure on scholarships as part of the social costs of education, but scholarships represent a transfer of income rather than a genuine resource cost, so that Blaug *et al.* took account of public expenditure or scholarships only when estimating the out-of-pocket expenses of the average student.

2. *Total costs of education*

These various estimates of costs per pupil or student were combined to give the unit costs shown in Table 4. (Since the earnings forgone by pupils or students vary according to their age, the table represents the average unit cost over the whole of a course.)

Harberger's estimates of the social costs of education were based on assumptions rather than evidence, due to shortage of data. He simply estimated direct costs per secondary-school pupil or per student as a proportion of their earnings forgone, as calculated from age-earnings profiles. He made these estimates on the basis of two arbitrary assumptions, namely that direct costs equalled (a) 50 per cent of earnings forgone at each level or (b) a proportion of earnings forgone rising from 12 per cent at age 14 to 50 per cent at age 22. These were intended to be 'conservative estimates' of direct costs, in the light of Harberger's belief that in the U.S.A. direct costs were roughly twice the level of forgone earnings. In fact the cost estimates shown in Table 4 suggest that direct costs do amount to roughly 50 per cent of forgone earnings at the secondary and undergraduate level in India.

TABLE 4. Estimated social and private costs of education per pupil or student, India, 1960/61

	Social		Private
Level of education	Nalla Gounden	Blaug, Layard, Woodhall	Blaug, Layard, Woodhal
Primary	66	95	34
Middle	304	262	198
Secondary	61"	640	523
First degree (B.A. B.Sc.):			
Years 1 & 2 (Intermediate)	1 786	1 244	1 000
Years 3 & 4		1 976	1 661
Engineering degree (B. Eng.)	2 665	2 488	1 304
Engineering diploma	—	1 616	992
M.A.	—	2 870	2 061
M.Sc.	—	4 352	

SOURCE Nalla Gounden, op. cit., p. 352. Blaug, Layard, Woodhall, op. cit., Ch. 8.

3. *Adjustments to cost estimates*

The cost estimates shown in Table 4 represent the annual cost to society, or to the individual, of each level of education, provided there is no drop-out or repeating of classes. The earnings data refer only to those who have completed a given level of education, therefore estimates of benefits based on these data can be compared with the costs in Table 4 to show the rate of return to completing a given level of education in the minimum time with no repeating. However, in countries such as India, where both wastage and stagnation are high, Blaug *et al.* argue that 'it is only realistic to recognize that producing one more graduate means also incurring some more wastage'. Therefore, they make an adjustment to the cost estimates to allow for the fact that the actual number of years needed to produce a graduate exceeds the minimum number. They estimated, for example, that matriculation requires 4.5 years of secondary schooling, instead of the minimum of 3, and that to produce a graduate requires 7 years of university education, instead of 4, because of drop-out and repeating. Their estimates of the rate of return to education are calculated both including and excluding the costs of this extra time in order to test the effect of wastage on rates of return.

C. The private and social rates of return

Because of the use of different sources of data on earnings and costs and because of different treatment of such problems as unemployment, the various studies produce a range of estimates of the rate of return to education. In fact Blaug *et al* deliberately calculated a wide range of values for both private and social rates of return, based on alternative assumptions about wastage, unemployment, and the proportion of earnings attributable to education. One of the aims of their analysis was to test how sensitive rate-of-return estimates were to changes in assumptions about, for instance, the returns to uncompleted education, on which there is very little data. Rather than present single valued estimates of rates of return, they calculated 'maximum' rates of return, which make no allowance for the costs of wastage, the likelihood of unemployment or the influence of factors other than education in determining earnings, together with 'minimum' values, which include all possible adjustments, and an α coefficient of 0.50. They argue that the true 'expected' social rate of return is likely to fall between these two values:

> 'we are inclined to think that the expected rate of return would correspond to the fully adjusted rate with $\alpha = 0.65$ if current wastage and unemployment rates continue as well as current demand and supply relationships ... but the reader is free to adopt any alternative set of assumptions'.

When it comes to the private rate of return, they argue:

> 'we are less concerned with the mathematical expectation of the rate of return, as individual students will place different values on their own chances of drop-out, retardation and unemployment. The crude (unadjusted) private

> rate of return represents the optimist's expected rate and the fully adjusted rate corresponds to the expected rate of the student who regards his chances as average'.[1]

Because of the differences in assumptions, one would not expect to find that the actual values of the rate-of-return estimates were the same in different studies, but the same general pattern emerges from all the studies, namely that the social rate of return to education in India probably lies between about 9 and about 16 per cent, and that the rate of return appears to be higher for primary education and engineering than for secondary or general higher ecudation. Both Nalla Gounden and Blaug *et al.* estimate that the lowest rate of return is to a bachelor's degree in arts or science. Harberger found a higher rate of return to university education, but he took bachelors' degrees and postgraduate degrees together.

Table 5 shows estimated social rates of return from all three studies. The rates of return shown for Blaug *et al.* represent the authors' 'expected' rate of return, that is, after adjustments for wastage, unemployment, growth of incomes and $\alpha = 0.65$; these estimates use the Urban Income Survey data as evidence of benefits. Harberger's estimates are based on his higher cost estimates.

Blaug *et al.* compared the estimates of rates of return from their five sources of earnings data, and found, on the whole, considerable consistency between the estimates. For example, the range of estimates of the rate of return to an engineering degree was 9.7 per cent to 11.5 per cent, depending on the source of data; the rate of return to a first degree in arts or science ranged from 5.2 per cent to 8.7 per cent, and the rate of return to primary education from 13.7 per cent to 14.5 per cent. They concluded that 'although there are considerable differences in pay scales in different industries, the level of earnings differentials is sufficiently similar to produce a very stable pattern of rates of return'.

TABLE 5. Estimates of the social rate of return to education in India

Level of education compared with lower level	Blaug, Layard, Woodhall	Nalla Gounden	Harberger
Primary/illiterate	15.2	16.8	—
Middle/primary	14.2	11.8	—
Matriculation/middle	10.5	10.2	11.9
First degree (B.A. B.Sc./Matriculation)	8.9	7.0	
Engineering degree/Matriculation	12.5	9.8	—
Graduate—post-graduate degree/Matriculation	—	—	16.9
Engineering diploma/Matriculation	11.3[1]	—	—

1. Calculated from machine tools industry data.

In addition, they produced estimates of the private rate of return, which were in every case (except one) higher than the corresponding social rate of return.[2]

1. M. Blaug, P. R. G. Layard, M. Woodhall, op. cit., Ch. 9.

2. The one exception is interesting because it shows that where exceptionally high earnings accrue to graduates of arts and science the tax they pay is sufficient to compensate for the subsidy

Their estimates of private rates of return calculated from Urban Income Survey data ranged from 10.4 per cent to 18.7 per cent, and once again showed that primary education was the most profitable form of investment, and a bachelor's degree in arts or science the least profitable.

II. Methodological lessons from the three studies

Because of the weaknesses of his data, Harberger's estimates of the rate of return to investment in Indian education are probably the least reliable of the three sets of estimates, but Harberger himself emphasized 'this is certainly not the best set of data that one could imagine for estimating the rate of return to investment in education'; but at the time of writing, it was the best available for India, and Harberger's aim was 'to squeeze as much juice as possible out of the "lemon" '. His attempt to calculate rates of return is interesting for a number of reasons. First, he recognized from the outset that lack of reliable data would introduce possible sources of bias into his estimates of rate of return, and said 'at this early stage I had to decide whether I would aim for an under-estimate or an over-estimate of the rate of return to education, and I opted for an over-estimate'.

This policy of consciously trying to influence the direction of the bias, by taking, wherever possible, the upper estimate of benefits and the lower estimate of costs, could be justified on the grounds that the measure of benefits excludes certain social benefits of education, so that an 'over-estimate' of the rate of return, as conventionally calculated, is more likely to be close to the 'true' social rate of return than an under-estimate. Unfortunately not all of Harberger's assumptions do result in an upward bias. For example, he assumed that age-education-earnings profiles were relatively flat, whereas actual data suggest that they rise fairly steeply during working life to a peak at the age of 40 and 50. He justified this assumption by emphasizing that 'the steeper the age-earnings profile of a given mean earnings, the greater the fraction of total income received late in life, and hence the smaller the present value of a given total income'.[1] However, it is also true that the flatter the age-earnings profile, the higher the level of earnings forgone, which enter into the cost side of the calculation, and receive a high weighting because of the process of discounting. Therefore it is not obvious that by assuming relatively flat profiles Harberger did produce an over-estimate of the rate of return to education. Other assumptions of the calcula-

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they received as students. On the other hand engineering graduates, who also receive exceptionally high earnings, still have a high private rate of return since engineering education is heavily subsidized.

1. A. C. Harberger, op. cit., p. 23.

tions are also likely to have counteracting results. For example, Harberger attributed the whole of the earnings differential associated with education, to the extra education, which will lead to an over-estimate of benefits; on the other hand, he neglected to take account of any future growth in incomes as a result of general economic growth, and this omission would produce an under-estimate.

Despite these grounds for doubting the accuracy of Harberger's numerical calculations of rates of return, his application of cost-benefit analysis is interesting because of the extensive use he made of admittedly very limited data. If his analysis is regarded not so much as an estimate of the relative profitability of education as an attempt to explore the implications of alternative assumptions about the costs and benefits of education, it is a valuable application of cost-benefit techniques. Harberger himself concluded that his study demonstrated the need for a more detailed analysis of the rate of return to different types of education in India, in the belief that 'a number of detailed surveys, yielding age-income profiles of various types and levels of education, would surely be worth their cost'.

This was attempted by the other authors, and their estimates of rates of return are interesting because of the variety of adjustments introduced, to take account of such problems as unemployment and wastage. An important feature of the analysis of Blaug *et al.* is their use of 'sensitivity analysis' to test the effects on rates of return of alternative assumptions about, for instance, the returns to drop-outs and the proportion of earnings attributable to education. This analysis revealed some information that can be applied to other estimates of rates of return.

For example, it demonstrated that the existence of unemployment, even though this is a severe problem in India, did not materially reduce the rate of return to education, particularly the private rate of return to a first degree in arts and science. Many observers have argued that the fact of graduate unemployment reduces the rate of return to university education to zero. However, in a situation where there are high levels of matriculate unemployment, which reduce the forgone earnings of undergraduate students, it is nevertheless profitable for individuals to choose to go on to higher education. When average rates of unemployment are used to calculate the 'expected' lifetime earnings of educated workers, including a period of unemployment, we find that benefits still exceed costs, even though the rate of return is lower than if unemployment is simply ignored.

Another by-product of this 'sensitivity analysis' was the discovery that the ability adjustment (that is, reducing the earnings differential attributable to education by means of an 'α coefficient') reduced the rate of return, but by less than the amount of α. For example, the assumption of $\alpha = 0.5$ gave an adjusted rate of return, on average, of about 0.65 the crude, unadjusted rate, the actual effect depending on the time distribution of costs and benefits. This is because the rate of return measures the *relationship* between costs and benefits, and an adjustment, such as the ability adjustment, which reduces the *magnitude* of benefits does not produce an exactly proportionate change in the rate of return.

Because of the mechanism of discounting, which gives less weight to the future than to the present, any adjustment which affects costs is likely to have a greater

effect on rates of return than an adjustment which affects benefits. Therefore, the assumption that all the costs of educating drop-outs and repeaters (including additions to earnings forgone) must be included when calculating the rate of return to producing an additional matriculate or graduate, has a substantial effect on the rate-of-return calculation; the 'wastage adjustment' usually lowered the rate of return to education by about 4 percentage points. Of course, if the economic returns to drop-outs are substantial, the 'true' rate of return to education will be higher than this adjusted rate of return, but this calculation demonstrated the importance of high wastage rates in reducing the over-all profitability of investment in education in developing countries.

III. The policy implications of rate-of-return analysis of Indian education

Since the objectives of the authors of these three Indian studies were slightly different, the policy conclusions that they draw from their analyses differ substantially. However, it is possible to distinguish between two broad categories of conclusions, those that deal with the over-all allocation of resources to education, and those that are concerned with the internal distribution of resources within education. In addition some conclusions are drawn concerning the problems of educated unemployment and wastage.

A. The allocation of resources to education

One of the purposes of cost-benefit analysis of education is to compare the profitability of education with other forms of social or private investment. Thus, Harberger compared his rates of return to education with an estimate of the average rate of return on physical capital in India. The estimation of the costs and benefits of investment in physical capital is beset with problems, as is the estimation of costs and benefits of human capital formation, so that once again it is impossible to arrive at a single estimate, and the actual rate of return depends on various alternative assumptions, for instance about the net replacement cost of physical capital, or the significance of market imperfections on the relative prices of labour and capital. But Harberger estimated a range of values for the rate of return to physical capital, using data from a survey by the Reserve Bank of India covering 1,001 companies in virtually all industrial sectors. After a variety of adjustments to these data, Harberger estimated the marginal productivity of physical capital equipment to be between 17.2 per cent and 26.1 per cent, and concluded 'I certainly think that it is fair to conclude that physical capital is highly productive in the

industrial sector of the Indian economy'.[1] A comparison of these rates of return with his estimates for education created 'a very strong presumption that the economic productivity of investment in physical capital exceeds the economic productivity of investment in education in India'.[2] If educational planners seriously applied cost-benefit criteria when allocating resources to education, this would imply that resources should be transferred from education to the industrial sector of the economy.

Harberger does not himself draw this conclusion, for he recognizes that 'the goals and rewards of education are not exclusively economic'. Indeed a straightforward prescription to invest less in education, simply as a result of this analysis, would be seriously misleading, since the estimation of benefits included only direct economic benefits, and even this is based on admittedly imperfect data. The policy implications that are drawn from the analysis are first, that educators should try to increase the economic profitability of education, for instance by follow-up studies of graduates of different institutions, in order to see what are the differences in the costs and benefits of different types of education, and secondly that further research should be carried out on the economic consequences of education. Harberger sums up his interpretation of this cost-benefit analysis thus:

> 'Educational techniques surely differ from institution to institution, and with careful follow-up studies it should be possible to discover some determinants of later economic success about which educators can do something. I suspect that it will turn out that many actions can be taken by educators to raise the economic productivity of their students without in any way detracting from the cultural and other advantages of the educational process. The key, I think, is to recognize that education *is* an investment ... A really serious effort to understand the economic consequences of different detailed types and classes of investment in education would help greatly to improve the contribution that education can make to economic progress'.[3]

Thus, despite the title of his study, Harberger concludes by pointing to its implications for decisions *within* the educational system, rather than arguing for a re-allocation of resources away from education, and states: 'I prefer to regard this study as suggesting future research rather than as indicating particular alterations of existing investment patterns.'

Nalla Gounden does, however, use the disparity between estimates of the rate of return to human and physical capital in India to propose 'redistribution of investable resources' on the grounds that

> 'the present emphasis on education in resource allocation may not help rapid economic growth and *per capita* income, because the rate of return is relatively lower in education. As a consequence, the economy's capacity to support education, and the actual resources available for education, in

1. A. C. Harberger, op. cit., p. 17.
2. Ibid., p. 29.
3. Ibid, p. 33.

the course of time may dwindle, and educational development itself will suffer'.[1]

This conclusion is reached simply by comparing the rate of return to education with Harberger's estimated returns to physical capital.

Blaug *et al.* discuss at some length the concept of the alternative rate of return, with which educational rates of return should be compared. Even when considering the alternative rate of return for private investment decisions, they argue that 'the concept of a unique alternative private yield on financial assets is beset with many difficulties', and yet the question of alternative social rate of return is 'beset with even more difficulties'.[2] Having reviewed the evidence of borrowing and lending rates of interest for individuals, they suggest an alternative private rate of return of 8 per cent. The question of the alternative *social* rate of return is more complicated, and depends partly on the extent to which some of the social costs of education (notably forgone earnings) are financed by reduced consumption, rather than reduced investment. Having reviewed several estimates of the yield on physical capital in Indian industry, together with a rough estimate of the social time preference rate in India, they conclude that 12.5 per cent represents a reasonable estimate of the alternative rate of return to education.

In the light of these estimates is there evidence that education as a whole is over-expanded? In terms of the returns to the individual, the answer, clearly, is 'no', since even allowing for the existence of unemployment and wastage, most private rates of return exceed 8 per cent. When they turn to the social rate of return, the picture is more confused, since some rates of return exceed 12.5 per cent, and others fall below. They conclude, therefore, that there should be a re-distribution of resources *within* education, but do not argue for a general transfer of resources away from education.

The conclusion that resources sould be transferred away from education would depend crucially on the importance attached to non-economic, or indirect, benefits of education. All the authors recognize that their estimates of benefits exclude these non-monetary returns, so that it is extremely difficult to use their results to justify an over-all shift of resources to other forms of investment.

B. The allocation of resources within education

This problem is not so crucial when we turn to the implications of cost-benefit analysis for decisions on distribution of resources within education. For even if rates of return exclude consumption and spillover benefits, this will not affect conclusions about the *relative* profitability of different types of education unless it is also argued that, for instance higher education generates greater external benefits than primary schooling. Blaug *et al.* accept the thesis that the marginal social product, that is the true contribution to social welfare, of an educated

1. Nalla Gounden, op. cit., p. 358.
2. M. Blaug, P. R. G. Layard, M. Woodhall, op. cit., Ch. 1.

worker may exceed his earnings, but assume that the gap between private and social product is the same for primary-school leavers as for graduates. If this is so, then the fact that the social rate of return to primary schooling exceeds all other educational rates of return, whatever assumptions are adopted about the magnitude of benefits, suggests that there should be an expansion of primary education at the expense of secondary and higher levels, up to the point at which social rates of return are equalized.

In fact, they argue, consideration of some of the non-economic goals of education serves to strengthen the argument for a re-allocation of resources to primary education. For instance, equalization of educational opportunity is one of the declared objectives of Indian educational planners; but,

> 'most people would think that the inequality that exists between an illiterate and someone with primary education was much more serious than the inequality between a matriculate and a graduate. If the goal were equity rather than efficiency, there can be no doubt that too much of the educational budget has gone to the higher levels and too little to the lower levels of the educational system'.[1]

Similarly, Nalla Gounden concludes that rate-of-return analysis underlines the criticism 'that Indian education is heavy at the top and weak at the bottom'.[2]

This conclusion, that resources should be re-allocated within the educational system, should not, however, be interpreted as support for a massive expansion of primary education in too short a time. It was emphasized earlier that rates of return reflect the present balance between demand and supply. All the estimates of rates of return show that in terms of this balance primary education is the most profitable form of investment in India. However, a sudden attempt to introduce universal primary education would totally change the balance between demand and supply. These rates of return indicate the desirability of gradual shifts in priorities, rather than massive reversals of present policy. A large-scale expansion of primary schooling should be accompanied by forecasts of expected changes in salary structures, which will in turn change the rate of return to primary education.

One proviso is needed here; the rates of return calculated by all the authors used data only from urban India. No one has yet succeeded in measuring the returns to education in rural India. Most matriculates and graduates do work in urban areas, but many primary-school leavers do remain in rural areas. Further work on the measurement of the economic benefits of education in rural areas would be extremely valuable.

C. An explanation of educated unemployment

Blaug *et al.* began their study by asking what were the causes of educated unemploy-

1. M. Blaug, P. R. G. Layard, M. Woodhall, op. cit., Ch. 10.
2. Nalla Gounden, op. cit., p. 357.

ment and the reasons why it had persisted for more than twenty years. Traditional explanations, for instance that it is a merely fictional phenomenon, or that it is due to unrealistic subject choice among students, were rejected, in the light of the fact that the proportion of educated manpower that was unemployed had remained constant for a long period, and that science graduates were unemployed as well as arts or law graduates.

Part of the explanation of the persistence of the unemployment is undoubtedly the existence of labour market imperfections, and 'all those factors which inhibit the adjustment processes of labour markets for educated people'. The study includes some discussion of these factors, and an analysis of the labour market mechanism, as well as the cost-benefit analysis of education which is the subject of this case study. The reason for including such cost-benefit analysis in a study of educated unemployment is that classical economic theory suggests that unemployment will lead to a fall in the wages of graduates and matriculates, until the supply of educated workers declines, showing that secondary and higher education have ceased to be a profitable form of investment, yet this appears not to have happened in India. A comparison of social and private rates of return provides a clue to this riddle.

A historical analysis of wage rates included in the study showed that there had, in fact, been a fall in the wages of educated people in India, but the cost-benefit analysis also showed that the private rate of return on all forms of education is still high enough to justify individual decisions to remain in secondary and higher education. The authors conclude: 'educated unemployment has worked to reduce the earnings of the educated, exactly as predicted by economic theory, but the decline has never been fast enough to reduce the incentives to acquire still more education. Supply has moved consistently ahead of demand, so that educated unemployment as a fraction of the stock of educated manpower has remained relatively constant'.

Thus Blaug *et al.* differ from most commentators on Indian educated unemployment, who explain its persistence in terms of a structural imbalance between the demand for and supply of educated manpower, but who concentrate on the demand side, and on imperfections in the labour market. The authors of this study accept the need for an 'active manpower policy', designed to remedy these imperfections, but they also place far more emphasis than other writers on the importance of the supply of educated people, and use their estimates of the private rate of return to show why individuals continue to demand education in the face of unemployment.

This emphasis on the use of cost-benefit techniques to analyse the nature of private incentives to investment in education is an interesting feature of this Indian study. For many of the objections to rate-of-return analysis do not apply to calculations of the *private* rate of return. For example, even if earnings do not reflect the marginal productivity of educated workers, the fact that education yields a positive private rate of return in excess of alternative private rates will provide an incentive for individuals to acquire additional education. This helps to explain the tremendous political pressure in India for the expansion of secondary

nd university education, despite the existence of unemployment, and despite low social rates of return. Thus, if Indian educational planners seriously want to limit the rate of expansion of higher education, on grounds of *social* cost-benefit analysis, one way to achieve this is by taking measures to reduce the *private* rate of return.

The authors argue that a policy of gradually raising fees in higher education, coupled with generous provision of scholarships for the needy, would lead to a reduction in the private demand for higher education. This should not, of course, be the only remedy attempted. Policies designed to improve the demand for educated manpower, and measures to improve the functioning of the labour market, such as more flexible hiring policies in the public sector, measures to increase mobility of workers, and more extensive use of employment exchanges and vocational guidance are also advocated. But the evidence of high private rates of return to education in India emphasizes the importance of simultaneously attacking the problem from the supply side, and suggests that any policy that ignores the behaviour of economic incentives to individuals to invest in education will fail to halt the steady growth in the number of educated unemployed.

D. The quality and efficiency of education

The evidence that including the costs of wastage and repeating in a calculation of social rates of return reduces these rates by about 4 percentage points emphasizes the need, stressed by many other writers, to improve the quality and efficiency of education in order to reduce drop-out and stagnation. Nalla Gounden also attempted to measure the rate of return to uncompleted primary education, by comparing the earnings of 'literates without completed primary schooling' with illiterates and primary-school leavers, and found a lower rate of return to literacy alone than to completed primary schooling. From this he concluded 'drop-outs are not economically as productive as completers; this suggests that the quality of education should be improved, and wastage and stagnation reduced'.[1]

This emphasizes again the fact that rate-of-return analysis can be used in two ways: (i) as a justification for diverting resources from types of education with low rates of return in favour of those offering a higher yield; and (ii) as a justification for seeking to increase the rate of return on unprofitable forms of investment, by raising quality in relation to the cost.

In fact, Blaug *et al.* argue that the present policy of rapid expansion of higher education has led to a *decline* in quality. This view was argued forcibly by the Indian Education Commission :

> 'There is a general feeling in India that the situation in higher education is unsatisfactory and even alarming in some ways, that the average standards have been falling and that rapid expansion has resulted in lowering quality. The examination results, the reports of Public Service Commissions, the views of employers, and the assessment of teachers themselves, the results

1. Nalla Gounden, op. cit., p. 357.

> of research done—all seem to support this conclusion... This situation has been in existence for a long time. What is new is the magnitude of the problems and their accentuation as a result of the extraordinarily rapid expansion of higher education and the development of new expectations in the post-independence era ... It is obvious that, if higher education is not radically improved, our administration and technical progress, our intellectual standards and social advance will all be most seriously handicapped'.[1]

This plea for a greater attention to quality, rather than quantity, of higher education is reinforced by the fact that the inclusion of the costs of wastage and repeating, when calculating the social rate of return to a first degree, reduces the rate of return from 12.7 per cent to 8.8 per cent. Thus cost-benefit analysis can provide an estimate of the grave economic consequences of high wastage and repeater rates.

IV. General lessons for educational planning

Another case study[2] in this series examines some of the general lessons to be drawn from an example of cost-benefit analysis. This Indian study reinforces many of these lessons, and in some respects provides some additional insights about the use of cost-benefit analysis in developing countries.

As in Colombia, it is impossible to say whether the cost-benefit studies of Indian education have had any significant impact on Indian educational policy. The policy conclusions derived by the authors of the studies are politically unpalatable, as they themselves recognized, and so far there has been no evidence that the rate of expansion of higher education has been affected by these cost-benefit calculations. However, as in the other case study, we can perhaps suggest some policy conclusions that might be drawn from this type of analysis in the future.

A. Rate-of-return analysis and labour market policy

In the past, some observers have argued that cost-benefit analysis cannot be applied in developing countries because of the existence of unemployment. On the contrary, the Indian experience suggests that not only can adjustments be made to cost and benefits estimates, to take account of unemployment, but that calculation of rates of return may even provide one key to the puzzle of persistently

1. Report of the Indian Education Commission.
2. *Colombia: the use of cost-benefit analysis to compare the rates of return at different educational levels*, in this volume (p. 247).

high unemployment, coupled with high rates of demand for education. This emphasizes the need for educational planning to include consideration of private economic incentives, and, if necessary, the changing of these incentives, and also to include an active policy to improve the functioning of the labour market, as one means of balancing the supply and demand for educated manpower.

For the persistence of imbalance between demand for and supply of educated manpower needs to be attacked on both fronts simultaneously. The authors of these cost-benefit analyses of Indian education argue for a reduction in the expansion of higher education, and a re-allocation of resources in favour of primary education. If this were achieved, it would help the problem of unemployment, by reducing supply in relation to demand. But equally, measures are needed on the demand side to increase substitutability between different types of workers, to increase labour mobility, and to reduce inflexibilities in the labour market. All too often such factors as hiring and salary policy in the public sector, or the functioning of employment exchanges, are regarded as quite distinct from educational planning. Yet without some consideration of these issues it may be impossible for manipulation of the education system alone to produce equilibrium between the production and the utilization of educated manpower.

B. The need for sensitivity analysis of rates of return

The conclusion that single-valued estimates of rates of return to education are to be avoided, and that sensitivity analysis of the effects of alternative assumptions on rates of return may produce useful results, is very strongly supported by these studies. The effects of some possible adjustments to crude earnings differentials have been examined for the first time. This showed that some adjustments to costs and benefit estimates, notably those for wastage and ability, have more effect than other adjustments, such as an unemployment or a mortality adjustment. This serves to make rate-of-return analysis of education a more flexible tool for planning, and overcomes some of the objections to crude estimates of rates of return. It is interesting, however, that none of the adjustments to the Indian rates of return change the *relative* pattern of profitability of different types of education. Thus, whatever adjustments are made to costs or to benefits, a degree in arts or science remains the least profitable form of investment, and primary education the most profitable.[1]

1. A more recent study than the Indian ones examined here comes to a similar conclusion: M. Selowsky in *The effect of unemployment and growth on the rate of returns to education: the case of Colombia* (Cambridge, Mass., Harvard University Center for International Affairs, Economic Development Report No. 116, November 1968) makes similar adjustments to his estimates of rates of return, in order to allow for unemployment and future growth of incomes and concludes: 'the introduction of more complex estimations of the internal rate of return which take into account unemployment and growth of both the economy and the educational sector does not change the priorities provided by more simple estimations'.

C. The need for more analysis of indirect and non-monetary benefits of education

It is now becoming commonplace to emphasize that rates of return, as traditionally measured, exclude non-economic and even some of the economic benefits of education. This case study has shown that until more headway is made on this crucial problem, it will be impossible to draw general conclusions about the proper allocation of resources *to* education, as opposed to *within* education. A serious attempt to analyse, if not to quantify, some of these more elusive benefits of education would surely increase the usefulness of cost-benefit studies in education.

D. The importance of measures to reduce wastage

The study by Blaug *et al.* is the first rate-of-return study which explicitly attempts to measure the economic consequences of high wastage rates, and it demonstrates the severe costs that wastage imposes on society. Thus an attempt to reduce wastage and repeating in many developing countries is likely to significantly improve the relationship between benefits and costs of education. It is true that a successful attempt to reduce wastage may increase tuition costs, but it will also reduce the forgone earnings of students, so that the net result is likely to increase the rate of return.

E. The feasibility of cost-benefit analysis in developing countries

Lastly, perhaps not the least of the general lessons to be drawn from this case study is that despite the existence of imperfections in the labour market, and despite considerable differences between industries in their wage levels and hiring policies, there appears to be very marked consistency in the results of rate-of-return calculations based on different sources of earnings data in India. Altogether these studies yielded over 200 estimates of the rate of return to different levels of education, based on different assumptions, and on different sources of data. The actual magnitude of the rate of return differs, but the relative position or ranking of different types of education remains roughly the same, no matter what sources of data are used, or what assumptions made about the impact of unemployment, or of factors such as ability or social background on earnings.

Harberger concluded his study with the statement:

> 'It seems to me that a number of detailed surveys, yielding age-income profiles of various types and levels of education, would surely be worth their cost. Their results would be exceedingly useful in the process of educational planning in India, even though it is recognized that the goals and rewards of education are not exclusively economic'.[1]

1. A. C. Harberger, op. cit., p. 33.

The later studies have shown that more detailed studies may in fact provide considerable information about the extent of shortages and surpluses of educated manpower, and the relative costs and benefits associated with different types and levels of education, both for the individual and society.

This information can be used to judge the effects of an increase in the supply of a particular category of educated manpower, the effects of a change in relative earnings or a change in the level of fees charged in schools or colleges. In addition the social rate of return gives the educational planner some guide as to the purely economic consequences of the existing distribution of resources in education, and the private rate of return helps to explain the demand of individuals for additional education. To be sure, rates of return cannot provide the complete answer to problems of resource allocation, simply because educational planning is trying to satisfy many different objectives, and even economic benefits of education are not fully measured by rates of return. The authors of one of the Indian studies conclude that rates of return cannot *by themselves* constitute a sufficient basis for educational planning, but that they are nevertheless useful, simply because:

> 'individuals do pay *some* attention to the costs of schooling and to the careers that different amounts and types of education will open up for them and, secondly, because the earnings of educated members of the labour force may provide the State with a rough guide to the economic contribution of education'.[1]

Thus, the conclusion of this review of cost-benefit analysis of education in India is that it can provide some evidence on the implications of alternative allocations of resources, and also emphasize the importance of private returns in determining the demand for education, but it does not provide a panacea for planning problems. Also its usefulness will be increased if it is used in conjunction with other analytical tools, such as analysis of labour market conditions. Perhaps the most important lesson from these studies is that planners should attempt to take account of both the total opportunity costs and the effects on relative wages of any proposed educational project or expansion. Cost-benefit analysis of education in India does not provide wholly satisfactory answers to the problem of resource allocation, but it does provide information on both these vitally important issues.

1. M. Blaug, P. R. G. Layard, M. Woodhall, op. cit., Ch. 1.

Colombia *18*

The use of cost-benefit analysis to compare the rates of return at different educational levels

prepared by Maureen Woodhall

This study was prepared by Maureen Woodhall, IIEP. This case study, based on a research memorandum prepared by the Rand Corporation, takes into account valuable comments made by several experts, including the author of the original memorandum, Paul Schultz.

Introduction

This case study examines a Research Memorandum, prepared for the U.S. Agency for International Development by the Rand Corporation, which attempted to evaluate education as a form of investment in Colombia.[1] The research memorandum presented estimates of the costs and benefits and the relative rates of return for the three main levels of formal education in Colombia in terms of their contribution to the future productive capacity of educated workers.

The study estimated the economic benefits of education accruing to individuals (men and women shown separately), and then compared these benefits with the private costs of education to arrive at estimated *private rates of return* for primary, secondary-general, secondary-vocational, and university education. Using the estimated private benefits as a proxy-measure (and admittedly an imperfect measure) of economic benefits to society as a whole, the author compared these benefits with the *social* costs of education to arrive at a *social* rate of return for each educational level. The study did not attempt to measure the *full* social benefits of education; it explicitly omitted any estimate of indirect economic benefits and of social benefits; hence the author claims only to have estimated a 'partial' social rate of return. Part I of this case study will examine the estimates of private and social rates of return to education in Colombia, emphasizing such matters as the adequacy and reliability of the data, the types of methodologies employed, and their inherent limitations; Part II will consider the potential policy implications of the cost-benefit analysis for Colombia, and Part III will discuss possible lessons for other countries.

I. Estimates of the private and social rates of return to education in Bogotá, Colombia

A. The theoretical framework of the study

The Schultz study of Colombia for the most part adopted the same theoretical framework and assumptions as most previous cost-benefit studies of education, including, for example, those of T. W. Schultz (not to be confused with the author of the Colombia study) and G. S. Becker.[2] In all these cases formal educa-

1. T. P. Schultz, 'Returns to Education in Bogotá, Colombia', Rand Corporation Memorandum No. RM-5645/AID, September 1968. The figures used are in general those of September 1965. Where figures were not available at this time, earlier data were updated.

2. T. W. Schultz, 'Investment in Human Capital', *American Economic Review*, Vol. 51 No. 1, March 1961; *The Economic Value of Education*, New York, Columbia University Press, 1963 and

tion is treated as a type of 'human capital formation'—that is, as an investment of time and resources in the present which will increase productive capacity in the future. Education is regarded both as a form of *private investment*, which will increase the educated worker's own earning capacity, and as a form of public or social investment, which will increase the educated persons's future contribution to national income.

The conventional method of evaluating these two forms of investment is by measuring benefits in terms of the additional earnings of educated workers (compared with less-educated workers) and comparing these benefits with the costs of their extra education to give an estimate of the rate of return on the investment in their education. A comparison of *pre-tax earnings differentials* and the *total costs of education* to society as a whole (including expenditure on teachers, books etc., the value of buildings, and the production forgone by society because of the decision to educate students instead of enrolling them in the labour market) gives the *social rate of return to education*. A comparison of *post-tax earnings differentials* and the costs of education borne by the individual (including fees, expenditure on books and earnings forgone) gives the *private rate of return*.

The rationale for measuring the economic benefits of education to society by individual earnings differentials is based on the basic premise of classical economic theory that the earnings of different types of labour measure their respective marginal productivity or their additions to the total national product. This assumption, which is crucial to all cost-benefit analyses of education, is open to many objections, particularly in developing countries where major imperfections in the labour market and various structural factors in the whole economy distort the relationship between wages and the true marginal productivity of workers. The shortcomings of this assumption, however, have been discussed at length elsewhere, so will not be repeated here. The author of the Colombian cost-benefit exercise nevertheless uses the assumption, although acknowledging its deficiencies. He argues that 'a more useful assumption about labour market behaviour or a better theory of value has yet to be developed, and with due reservations this study adopts the standard classical assumptions'.[1]

Schultz also acknowledges another weakness in the current methodology of cost-benefit analysis. 'For private and social decisions on allocating time and resources to various levels of education, one wants information about the expected future age-earnings profiles for those about to enter the educational system. Data and methods ... are not now available for estimating these expected time-series profiles of earnings.' Thus he assumes, like other studies, that cross-sectional data showing the *present* earnings of workers of different ages, based on their *past* education, can be used to provide approximation for the expected *future*

'The Rate of Return in Allocating Investment Resources to Education', *Journal of Human Resources*, Vol. 2, No. 3, summer 1967; and G. S. Becker, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education*, New York, Columbia University Press 1964.

1. *Returns to Education*, op. cit., p. 4.

life time earnings of many of today's and tomorrow's students. He emphasizes, however, that cross-section data from the recent past 'measure very different relationships than those ideally sought for current decision-making'.[1]

The study does, however, make one departure from the standard methodology of cost-benefit analysis. Most previous estimates of the economic benefits of education have used empirical data on *annual earnings differentials* as the basis for estimating the extra lifetime earnings associated with a particular level of education. However, Schultz points out that 'the fact that schooling affects a person's productive capacity, increasing his potential earnings per hour worked, may alter his allocation of time between work and leisure'.[2] This is because education increases the earnings of the educated worker, thus changing the relative 'price' of work and leisure, and this may cause him to substitute work for leisure, or vice versa, according to the relative satisfactions he obtains from each activity. If an increase in annual (or weekly) earnings is taken as a measure of the effect of education on productive capacity this may be misleading, because the increased earnings will reflect both the workers' higher productivity and his substitution between work and leisure. The latter is not, of course, necessarily dependent on the level of education. Schultz therefore estimates the rate of return to education using both weekly earnings and hourly earnings differentials as a basis for measuring benefits, in order to test how sensitive the results of the rate-of-return analysis are to possible substitutions between work and leisure. However, even this refinement leaves many problems unsolved, as Schultz himself points out: 'The dual analysis undertaken here of both hourly and weekly earnings implicitly assumes that people select the number of hours they want to work and to devote to leisure activities independently of their educational attainment, and that the disutility of their work opportunities is unaltered by their schooling. Neither of these assumptions can be defended as realistic, but empirical work needed to formulate more realistic assumptions and quantify them has not yet been undertaken'.[1]

But these assumptions are unrealistic. Education does often change the satisfaction to be derived from work, by providing opportunities for more agreeable work. Becker showed that an estimate of the private rate of return should include as economic benefits of education both the increased earnings of educated workers (the *monetary* benefits), and any increase in the *psychological* benefits of their work.[3] However, the methods of measuring psychological benefits of different kinds of work are still very primitive. Another weakness of this assumption is that individuals may not voluntarily choose the distribution of their time between work and leisure where there are prescribed hours of work for particular jobs or when there are high rates of unemployment.

Some of the earliest studies of the rate of return to education simply measured

1. *Returns to Education*, op. cit., p. 9.
2. Ibid., p. 5.
3. Becker, op. cit., p. 38.

the economic benefits of education in terms of the total difference in lifetime earnings of the highly and less educated. This ignored the fact that earnings are dependent not only on differences in education but on differences in other factors, such as family and social background, natural ability, occupation, and region of work. Ideally the economic benefits of education should be measured by earnings differentials between workers identical in every respect except education, but this would require such a large survey of incomes and such sophisticated methods of multiple regression analysis that it is impossible in most countries. Therefore many examples of cost-benefit analysis simply adjust the observed earnings differentials of educated workers by an arbitrary coefficient to make some allowance for these non-educational factors.[1]

Schultz assumes that earnings are determined by five factors: age, education, sex, family income other than that earned by the worker himself, and the number of years since he left his birth-place if he is a migrant. Thus he ignores some of the factors that may help to determine earnings, such as occupation and natural ability, but his estimates of the economic benefits of schooling are nevertheless a considerable improvement.

Another shortcoming of the assumption that economic benefits of education can be measured in terms of differential wage rates is that in many developing countries unemployment and underemployment are heavy and therefore may reduce considerably the actual number of hours and weeks a worker may actually be employed during his lifetime. Schultz recognizes the importance of this problem in Colombia; the survey data on which his earnings estimates are based included about 11 per cent unemployed, and in addition he reduced the observed hourly earnings of workers to allow for some underemployment, before calculating rates of return.[2]

Two further major limitations of the study must be borne in mind in interpreting the significance of its results. While it is no doubt true that the labour survey used in the study was relatively better than most such surveys in developing countries, the sample was nevertheless a fairly small one. More important, perhaps, is the fact that it was confined to the capital city of Bogotá, where wage levels and relationships are probably quite different from those in the bulk of Colombia.

Therefore, while the author accepted most of the classical theory and conventional assumptions used in cost-benefit analysis, he was very much aware of their weaknesses and those of the statistical basis he had to use. The extent to which these limitations should affect the interpretation of estimates of the rate of return to education in Colombia or in other countries is discussed in Parts II and III.

1. The most commonly used value of the 'α coefficient', as it is often called, is 0.66, which assumes that two-thirds of the extra earnings of educated workers is attributable to education alone. This value was chosen, arbitrarily, by E. Denison in *The Sources of Economic Growth in the U.S. and the Alternatives Before Us*, but has since received some empirical support from multivariate analysis of income determinants in the U.S. No information is available, however, to suggest the most likely value for this coefficient in developing countries.

2. See *Returns to Education*, op. cit., p. 11.

B. The estimation of benefits

Data on earnings of male and female workers in Colombia were obtained from a household labour force survey of Bogotá, carried out in September 1965 by the Centro de Estudios sobre Desarrollo Económico of the Universidad de los Andes, Bogotá.[1] A sample of 684 males and 316 females, of ten years or over, were asked for information which included age-group, income, family income, hours worked, age of leaving native city, and period of unemployment.

Data drawn from the labour survey were used by the author of the cost-benefit analysis, first, to calculate regression coefficients between the reported income or earnings of the interviewed workers (assumed to be the dependent variable) and the five independent variables, and then to construct synthetic 'age-education-earnings profiles' for each of the four levels of schooling and for workers with no schooling (on the assumption that earnings were proportionately related to the other variables).[2]

The regression analysis suggested that earnings were positively related to age and to education, except that vocational schooling appeared to have had little effect on men's earnings and primary education showed no effect on women's earnings.[3] On the other hand, there was no indication that the length of residence in Bogotá affected earnings. In other words, although it is commonly believed that migrants earn less than workers born in a given place, the survey does not

1. The reliability of these data is discussed in R. Sligton, *Urban Employment in Colombia: Measurement, Characteristics, and Policy Problems*, RM-5393-AID, Rand Corporation, January 1968.

2. It was assumed that earnings (y) were a function of the independent variables:
S = years of schooling in the jth level, where j = 1 ... 4
A = age group, measured in terms of six groups, i = 1 ... 6
R = number of years since left native city, a proxy for years of residence in Bogotá.
F = other sources of family income, and an error term, μ.
The earnings function was assumed to be:

$$\text{Log } y = \beta_1 + \sum_{j=i}^{4} \beta_{2i} S_j \sum_{i=1}^{6} \beta_{3i} A_i + \beta_4 R + \mu.$$

The first stage of the exercise was to calculate the four regression coefficients, β_1 β_2 β_3 and β_4, using ordinary least squares regression analysis. Synthetic age-earnings profiles were then constructed. Because of the assumed form of the earnings function, for instance the assumption that the variables age and schooling are additive in their effect, these 'synthetic profiles' differ in some respects from observed age-education-earnings profiles in other countries, particularly with respect to the peak age of earnings. This however has very little effect on the estimation of rates of return.

3. Schultz suggests two explanations for the apparent lack of effect of primary education on female earnings: first, most of the women covered by the survey who had only a primary education or none at all were employed as domestic servants in Bogotá; second, the quality of primary schooling varies so much in Colombia that little market value is attached to possession of primary education. This illustrates the difficulty of generalizing about the economic benefits of education when information is available only for workers in one particular occupation, or where education nominally the same in fact differs considerably from one school to another. (This is also the case for 'university' education in Colombia, which in many institutions is in fact substantially below what is generally accepted as university level.)

support this belief. Similarly, the income of the workers' family appeared to have little effect on men's earnings, although women from a family with high income earned less than others, suggesting that other sources of family income may have had a disincentive effect for female workers.

The age-earnings profiles constructed from this data are shown in Figure 1. It shows the hourly earnings of men and women by level of education, after downward adjustment for unemployment and underemployment. No allowance is made for non-monetary income except in the case of female domestic workers, who receive a large part of their total earnings in the form of free lodgings and food. No evidence was available as to the extent of such 'fringe benefits', but it was thought that two-thirds of the total earnings of female domestic servants were received in kind, so that observed earnings were adjusted on this basis. Other workers may also receive substantial fringe benefits from employment, and if these are related to education, the earnings differentials derived from the age-education-earnings profiles in Figure 1 will under-estimate the financial benefits of education in Bogotá.

Next, the earnings were analysed from the point of view of the *social* benefits of education—those benefits, economic or non-economic, that accrue to society as a whole, including some which are not captured by the individual in the form of higher earnings.

One important difference between social and private benefits results from the incidence of income tax, which reduces the direct financial rewards of education for the individual but not for society, since society as a whole benefits from the higher taxes paid by the educated worker. Another important difference is that social benefits include various 'external' effects, or 'spill-over benefits', of education of both an economic and non-economic nature. Schultz provides no evidence about the average taxes paid by educated workers in Colombia and makes no adjustment for them in calculating benefits.[1]

He provides a short discussion of some of the possible external effects of education, treating them in a general way and not investigating their magnitude in Colombia. However, he points out that while primary education may produce external benefits for society by providing a literate population which may bring political benefits, or by reducing disparities in personal incomes and thus 'alleviating social turmoil and tension', and, perhaps most important, by reducing the high birth-rate, there is no evidence that neglecting the external benefits of education will lead to under-estimates of the benefits of higher, relative to primary or secondary education.

Since the main objective of the cost-benefit exercise is to compare the costs and benefits of different types of education, rather than to evaluate education as a whole in relation to other forms of social investment, the neglect of external benefits is not crucial, provided there are no substantial differences in the external benefits associated with different levels or types of education. It is perfectly

1. He considered nominal income tax schedules as an unreliable indicator in developing countries.

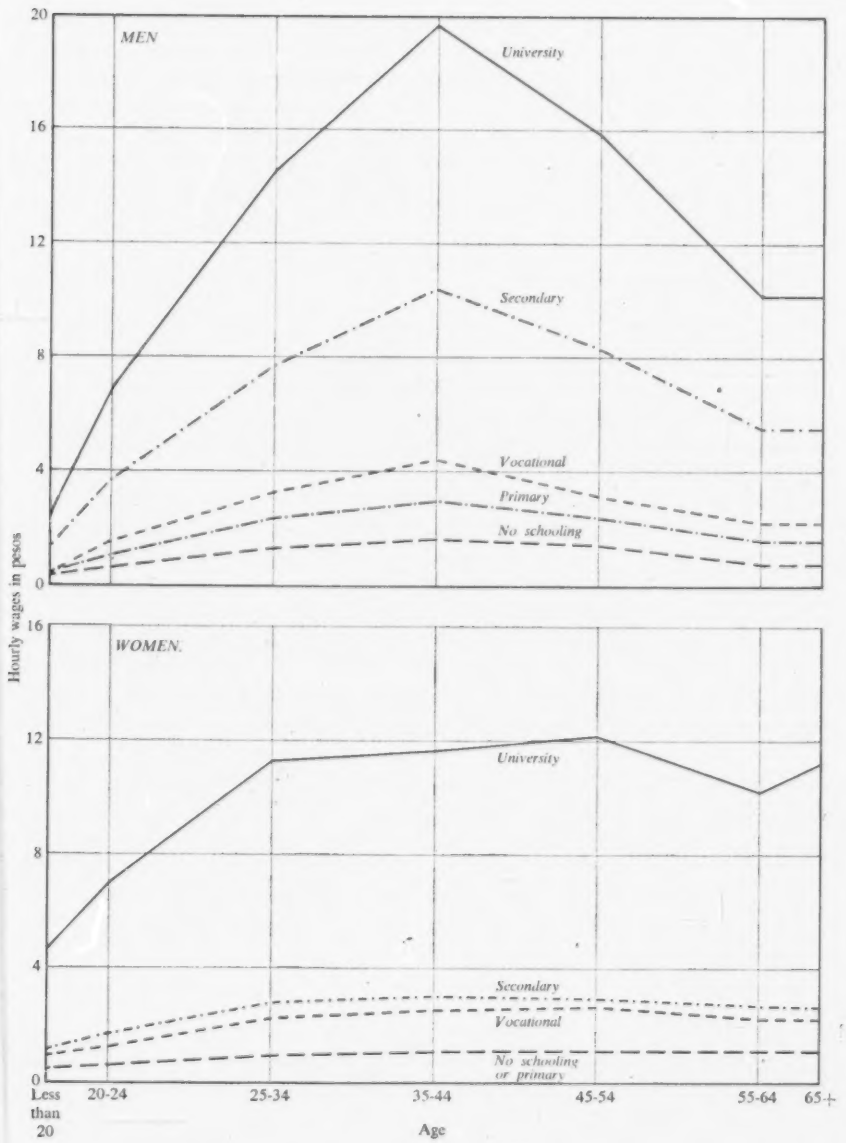

FIGURE 1. *Estimated adjusted wages of men and women by age and schooling; Bogotá, September 1965.*

possible that while education creates certain indirect political, social or economic benefits, such as a literate electorate, or a reduction in the birth-rate in an over-populated country, there are no significant differences between the external benefits of primary and secondary education. But the question of external benefits would be important if one were comparing the rate of return of education with the rate of return on health expenditure, or irrigation programmes, since it is unknown how the external benefits of education and health or irrigation compare.

C. The estimation of costs

1. *Private costs*

Private costs of education include direct expenditure by individuals on fees, books, etc., as well as indirect costs borne by the individual in the form of forgone earnings. Schultz used the earnings data described in the preceding section to estimate earnings forgone, and also used estimates of private expenditures on education collected in 1961/62 in a sample survey of 2,680 families.[1]

Table 1 shows the estimates of private costs of schooling in Bogotá, broken down into direct costs and opportunity costs (i.e. the opportunity cost of student time, as measured by earnings forgone). Schultz gives no estimation of the reliability of the direct costs, but he does point out that 'much uncertainty surrounds' the estimate of opportunity cost of student time. Strictly speaking, such an estimate requires an estimate of the value of their time in the next best alternative use. The use of earnings forgone as a measure of opportunity cost assumes that the student has the opportunity to work if not in school, and assumes that he is not working part-time while at school. Because of the uncertainty of both these assumptions in Colombia, Schultz makes three alternative estimates of the total opportunity cost of education. The first (which is shown in Table 1) is that earnings forgone, directly derived from the earnings data, measure the opportunity cost of students' time but that the time of primary-school pupils has no alternative value; in addition, he calculates a high and a low alternative value in order to see how sensitive the rate of return to schooling is to alternative assumptions about opportunity cost.

2. *Social costs*

The public or social costs of education include all expenditures on teachers, books furniture, materials and maintenance, and the value of school buildings, as wel

1. Guillermo Franco Comacho, *Rendimiento de la Inversión en Educación en Colombia*, Centro de Estudios sobre Desarrollo Económico, Universidad de los Andes, Bogotá, Colombia, July 1964. In order to allow for the effects of price changes between 1961/62, the time of the cost survey, and 1965, the time of the earnings survey, Schultz inflated the cost estimates by 63 per cent, the increase in the Bogotá price index during the period.

TABLE 1. Estimated cost of schooling in Bogotá (in pesos of September 1965)

Years of schooling	Assumed age	Direct costs		Opportunity costs[1]		Total costs of schooling	
		Male	Female	Male	Female	Male	Female
Primary							
1	9	633	536			633	536
2	10	689	616			689	616
3	11	750	708			750	708
4	12	816	815			816	813
5	13	888	934			888	934
Secondary (both courses)[2]							
1	14	954	1 016	442[3]	887[3]	1 396	1 903
2	15	1 025	1 105	553	968	1 578	2 073
3	16	1 101	1 202	691	1 056	1 792	2 258
4	17	1 181	1 305	864	1 152	2 045	2 457
5	18	1 286	1 372	1 080	1 256	2 366	2 628
6	19	1 400	1 443	1 350	1 370	2 750	2 813
University							
1	20	1 524	1 517	2 759	2 506	4 283	4 023
2	21	1 659	1 595	4 567	3 280	6 223	4 875
3	22	1 804	1 677	5 856	4 200	7 660	5 877
4	23	1 964	1 763	6 298	4 404	8 262	6 167
5	24	2 138	1 854	6 777	4 618	8 915	6 472
Vocational							
1	14	1 510	1 432	2 759	2 506	4 269	3 938
2	15	1 707	1 620	4 567	3 280	6 274	4 900
3	16	1 903	1 811	5 856	4 200	7 759	6 011

1. It is assumed that no opportunity costs are associated with primary-school attendance.
2. Academic and technical.
3. At first sight the relationship between the opportunity costs for men and women at the secondary level seems rather strange. However, a study of the regression functions shows that women with primary education earn one and a third times more per hour than men with primary education, and this is roughly equal to the average relationship between the opportunity costs of the two sexes at secondary level.

as the production lost by society because students are at school rather than working. To estimate the social cost of education in Colombia is complicated because of the diversity of organizations and individuals concerned in the financing of education. Government expenditure on education is divided between central government departments and the municipalities. In addition, education is substantially financed by religious and other private organizations, but there are no reliable data on these non-governmental expenditures, nor on the value of school buildings.

And because of the high rate of student drop-outs and repetition, particularly in primary schools, real cost of a *completed* primary-school course is far greater than would appear if total expenditure is simply divided by enrolments. This problem is particularly acute in developing countries and has more effect on estimates of the rate of return to education than some of the other possible sources of error or bias. For instance, because of wastage, it takes, on average,

the equivalent of 14 years of instructional cost to produce one qualified primary-school leaver in urban areas in Colombia, as against the norm of five years.[1] Thus the effect of wastage is to almost treble the costs of a complete primary schooling (if one charges the full costs only to those who finish). Moreover, if it takes the typical pupil 6 or 7 years to complete the five grades, this will also postpone his employment and thereby reduce the benefits. All these factors added together reduce the rate of return to primary education in Bogotá considerably.

There are two ways of treating this drop-out and repeater problem in an analysis of this sort. One way is to count only students who have *completed* a particular cycle and to charge *all* educational costs to them. This assumes, of course, that those who dropped out along the way would never enjoy extra earnings benefits from their incompleted schooling. While this may be a plausible and convenient assumption with respect to pupils who leave school before even learning to read or to add and subtract numbers, it is a very dubious assumption with respect to those who leave secondary school or the university before completing their courses, for they presumably learned *something* of value which may improve their earnings. The practical effect of adopting this first approach is to arrive at a lower rate of return, since cost per completed student will be higher and no provision is made for the income benefits of non-completers.

The second way, and the one used by Schultz, is not to limit the analysis to completers but rather to include everyone who has attended any portion of a given educational cycle. Thus, a person with two years of secondary schooling completed is included in the labour force sample, and his earnings are regressed against the secondary schooling variable of two. The regression estimate of the earnings effect of secondary schooling is, therefore, expressed in terms of years of school completed, not in terms of graduation. This procedure makes a direct adjustment for the somewhat lower probable return to initial and intermediate years of secondary education compared to the final year, in proportion to the frequency of initial and intermediate drop-outs in the labour force sample. For this reason, the drop-out rate did not seem to him to present an insurmountable problem for this form of cost-benefit analysis. But even this modification is not without its defects. For example, it fails to take account of the high cost of repeaters and their delay in entering the labour force; it implies educational benefits for large numbers of early primary-school drop-outs that may not in fact exist: and it results in not really giving a true comparison of the relative rates of return of a *full* primary, secondary and university education. However, it does compare the rate of return to investments in primary, secondary and university education.

Schultz is well aware of the various problems and of the imperfections of his solutions, but he is correct in pointing out that some of the inevitable errors may be partially off-setting. For example, primary-school costs tend to be understated because of the drop-out and repeater factor, whereas corresponding

1. Ministerio de Educación Nacional, *Oficina Administrativa para Programas Educativos Conjuntos O.A.P.E.C.* Toma 1, Bogotá, 1967, p. 51.

understatements of cost at the secondary and university levels result from neglecting church contributions to education.

In the absence of better data, his estimates of the social cost of education in Bogotá are derived simply by dividing total government expenditure on education by enrolment, including all students in publicly supported schools and half the number in private schools. The results are shown in Table 2. These cannot be considered an accurate estimate of the real resource costs of schooling in Colombia, but they do reveal certain significant patterns, such as the fact that the cost of secondary education per pupil is approximately four times the unit cost of primary education, while the unit cost of university education is forty times that of primary education.

TABLE 2. Colombia: estimated annual expenditures per student at various educational levels, 1962, and estimated social costs of education, 1965 (in U.S.$)[1]

	Primary education	Secondary education	Higher education
Total government operating cost, divided by students in 1962 in:			
Public schools	209	1 037	10 539
Public and private schools	155	377	4 152
Estimated social cost per student, 1965[2]	290	1 131	11 750

1. Though the private costs and benefits refer only to Bogotá whilst the social costs refer to the whole of Colombia, the likely error is not very great as there is unlikely to be any significant difference in the cost to the government of primary schools in different parts of the country.
2. 1962 government expenditure divided by public school enrolment + 50 % of private school enrolment, inflated by 1965 cost-of-living index.

SOURCE *Returns to Education*, op. cit., pp. 35 and 36.

Some refinements to these cost estimates would have been possible with further research, but in some instances (such as capital costs) it might not have had a very significant effect on the estimates of rates of return. For example, Schultz shows total government expenditure, broken down into operating costs and investment costs. The annual cost per student should strictly include not only operating costs but the estimated yearly value of all existing buildings and equipment. One solution to capital cost problems would have been to make alternative estimates of the imputed rent of school and university capital, based on estimated amortization of 1962 investment costs over the assumed life of the buildings and equipment. But previous studies have shown that estimates of the social rate of return to education are relatively insensitive to alternative assumptions about capital costs—the reason being that current costs typically far exceed capital costs in the total unit costs of education. On the other hand, if good data on drop-outs and repeaters were available for Colombia and had been worked into the cost estimates to give the average cost per successful graduate, this might have made a significant difference in the rate-of-return estimate.

D. The private and social rates of return

The purpose of this analysis of costs and benefits, as noted earlier, was to compare the rates of return to different levels of education.[1] Because of the alternative assumptions about the opportunity cost of students' time, and also because of the use of both weekly and hourly earnings as a measure of benefits, there is a wide range of alternative estimates of the rate of return. Nevertheless, a general pattern emerges which shows clearly the relative yield of each form of investment for the individual. Table 3 shows the estimated private rate of return to the four main types of education in Colombia, based on the average hourly earnings of men, adjusted for unemployment and under-employment, and based on the estimates of private costs shown in Table 1 (taking the 'middle' assumption about opportunity costs), and the range of values, for both men and women, based on alternative assumptions about costs or benefits.

The value of the rate of return to each level of education depends largely on the assumptions adopted about costs, but is less sensitive to changes in the assumptions about benefits. For example, the assumption that weekly earnings provide a better measure of economic benefit than hourly earnings reduces the rate of return to secondary education by only one percentage point, but the alternative assumptions about the level of opportunity cost produce a variation of ten percentage points. However, whatever assumptions are adopted, the ranking of the four levels of education remains the same; vocational and secondary education offer the highest rates of return, primary schooling has a high rate of return for men but indicates no monetary benefit for women, and university education offers a very low private rate of return to both men and women.[2]

The very high rates of return to vocational schooling deserve some comment. The data on earnings showed that the earnings of workers with vocational schooling were similar to or lower than the earnings of secondary-school leavers, but since their education required on average only three years after primary school instead of six for secondary, the rate of return is very much higher than for secondary schooling. However, the vocational-schooling category is very mixed, and the numbers in the sample were too small to allow a more detailed breakdown, so it is impossible to say which type of vocational education offers the highest rewards, although Schultz observes that 'casual empiricism suggests that the foreign language secretary and the bilingual clerk make a handsome return on their short period of vocational training'.[3]

1. The internal rate of return is a measure of the 'yield' of an investment, and represents the interest, or discount, rate which makes the present value of expected future benefits equivalent to the present value of costs.

2. This does not mean, of course, that additional education did not enable people to earn considerably higher incomes. As seen in Table 1, the average earnings of people who had attended primary, secondary and higher education, respectively, were roughly in the ratio of 3 to 10 to 20. However, the rate-of-return calculations also take into account the magnitude of costs, and it is this which explains the relatively low rate of return to university education.

3. *Returns to Education*, op. cit., p. 29.

TABLE 3. Estimated private rates of return to schooling in Bogotá, 1965

	Primary over no schooling	Secondary over primary	Vocational over primary	University over secondary
Based on adjusted hourly wages of men	18.4	34.3	52.5	4.4
Range of values for men, according to alternative assumptions	16.7 to 18.4	28.8 to 38.3	42.8 to 59.1	3.6 to 5.2
Range of values for women	nil	13.6 to 21.1	41.6 to 63.8	4.6 to 6.2

SOURCE *Returns to Education*, op. cit., p. 28, Table 7.

The hypothesis that education affects the distribution of time between work and leisure receives some support from this evidence. If weekly earnings are used as the basis for measuring earnings differentials, the rate of return is increased by two percentage points in the case of primary schooling but is reduced in the case of the subsequent levels of education. This suggests—if one assumes the initial earnings data to be accurate—that primary schooling may induce men to work longer hours than workers with no education, but that additional education has the opposite effect of reducing the number of hours worked.

Having presented these estimates of the private rate of return, Schultz emphasized three possible sources of bias, which are to some extent offsetting. Firstly, the fact that the rates of return are based on cross-section data from the *past* may produce an under-estimate of the *future* benefits of education if wage rates rise in the future as a result of rising productivity in the economy. On the other hand, he ignored the downward effect of taxation on net private earnings; strictly speaking, private rates of return should be based on *after-tax* earnings differentials, which measure the monetary benefits that actually accrue to the individual.[1] If the rates of return for Colombia had been based on after-tax earnings, the rates of return, particularly for university education, would have been lower, but it is impossible to determine by how much without detailed information on the incidence of taxation.

Thirdly, the fact that other factors, such as family background, which may help to determine earnings have been ignored in this analysis leads also to an over-estimate of the returns to education. Schultz observes that in Colombia 'schooling is likely to go to those with wealth and economic and social position in society; and this élite is also likely to influence the earnings, advancement, and success of its offspring by various actions'.[2] This source of bias is likely to be particularly important for those with university education, which suggests that even the low private rate of return of 4 per cent is an over-estimate.

When he turns to the estimation of social rates of return, Schultz emphasizes

1. The validity of this approach will be discussed in Part III.
2. *Returns to Education*, op. cit., p. 29.

TABLE 4. Estimates of private and social rates of return to education in Colombia

	Primary	Secondary	Vocational	University
For men:				
Private rate of return	18.4	34.3	52.5	4.4
Social rate of return	15.3	26.5	35.4	2.9
For women:				
Private rate of return	nil	16.0	54.7	5.1
Social rate of return	nil	13.5	39.8	3.5

SOURCE *Returns to Education*, op. cit., pp. 28 and 36.

the uncertainty surrounding both the social benefits and social costs, and for this reason calls his estimates 'partial social rates of return'. His calculations of social rates of return are based only on the adjusted hourly wages. Table 4 shows the estimates of both the private and social rate of return, based on adjusted hourly earnings of men and women.

As expected, the social rates of return are consistently lower than the corresponding private rates, which reflects the public subsidy of education. The ranking of the four levels of education remains the same.

E. Evaluation of the methodology of the exercise

The preceding sections have already pointed out some of the shortcomings of the estimates of costs and benefits in this study—shortcomings which the author himself was careful to emphasize.

This study of rate-of-return analysis has, however, one important strength—the use of sensitivity analysis to show the significance for rates of return of alternative assumptions about costs and benefits. This demonstrated that over- or under-estimation of the rate of return due to neglect of a change in the number of hours worked as a result of additional schooling was not very serious, but that adopting alternative assumptions about opportunity costs had a significant effect on rates of return.

On the other hand, there are two methodological weaknesses in the analysis: the neglect of the effect of taxation on private rates of return and the neglect of repeating. For purposes of international comparisons of private rates of return, it could be justifiable to calculate private rates of return on the basis of pre-tax earnings, since country differences in the structure of taxation, particularly the distribution of tax burdens between direct and indirect taxes, may make international comparison of the private returns of education *after* direct taxation misleading. If, however, the purpose of calculating private rates of return is to throw light on the economic incentives to acquire different types of education in one particular country, the incidence of taxation should clearly be taken into account, and by failing to do so, this study over-estimates private returns.

Wastage, as commonly defined, includes both repeaters and drop-outs. The author makes no allowance for the costs of repetition, which is high in Colombia, and thus he over-estimates somewhat the rates of return, especially at the primary level where repetition is perhaps greatest. However, he did take account of both the costs of drop-outs and the benefits accruing to them, by including in his earnings sample persons who entered but did not complete a given cycle. Thus his rates of return refer to the total returns from a given level of education. This is exactly what policy-makers want to know. They are not interested in the rates of return of those who pass and those who fail, because the system produces a composite output of passes, failures and drop-outs. A decision cannot be taken to invest only in people who will complete a given level of education.

One final comment should be made about the estimation, in this study, of the rate of return to women's education. The earnings sample included only those who were 'working or in search of work'. In view of the lower labour force participation rate for women some allowance should be made when calculating rates of return for the lower probability of women joining the labour force. In fact the application of cost-benefit analysis to women's education is complicated by the fact that the direct benefits are usually lower than for men because of lower labour force participation rates while the indirect benefits, especially 'inter-generation' effects, may be higher. Much more work remains to be done before useful comparisons can be made between rates of return to education for men and women.

II. The use of rate-of-return analysis for decision-making in Colombia[1]

The justification for analysing expenditure on education in terms of economic costs, benefits and rates of return is twofold, according to Schultz:

> 'It is assumed that a fundamental objective of educational policy is to increase the productivity of social resources in general, and enhance labour's productivity in particular. Information on the social and private returns to education are both relevant to the task of designing educational policy, for the social return signals the priorities for an efficient allocation of the society's

1. Although these conclusions refer to rates of return in Colombia the data refer only to the capital, Bogotá. Wages and salaries are likely to be considerably lower outside Bogotá, particularly amongst those with little education. Thus the rates of return for primary, and to some extent for secondary and vocational, education for the whole of Colombia will be lower than calculated. However, because of the very wide differences among the rates of return of the respective levels, the order of ranking would be unlikely to be different.

> resources, and the private return reflects the inducements to individuals to invest their resources in acquiring an education and applying their new skills to domestic employments ... In planning educational policy a country contends with two issues: what is the best social allocation of resources with regard to education, and how can people be motivated to acquire and to use their education in employments where social returns are highest.'[1]

The study draws some conclusions from the cost-benefit analysis for both areas of policy-making, although stressing that 'the basis of this study is much too limited to support detailed suggestions or normative judgements as to the direction of Colombian educational policy'.[2]

A. Conclusions on social resource allocation

The conclusions can be summarized as a justification for increasing the resources allocated to education, and as a suggestion that these resources be re-distributed in favour of primary, secondary and vocational, rather than university, education. Although rates of return in other countries are not strictly comparable, it is interesting to note that the comparison between the estimated Colombian rates of return and available estimates for other Latin American countries in Table 5 shows that the rate of return to secondary education is highest in Colombia, while the returns to university education are lowest. In this connexion it should be noted also that the rate of expansion of higher education in recent years has exceeded the rate of growth of primary, secondary or vocational schools in Colombia.[3] Cost-benefit considerations do not appear to justify this distribution of resources. If measures of the social rate of return to education are taken as a reflection of the *relative* economic profitability of investing additional resources in each level of education, then purely economic considerations would suggest a greater expansion of vocational, secondary and primary education. This argument does not rest upon the absolute *magnitude* of the rate of return, which as we have seen varies according to different assumptions, but on the *ranking* of the four types of education, which remains the same whatever assumptions are adopted.

One other possible justification for substantial public investment in higher education remains to be considered, namely, the possibility that university education offers greater indirect (or 'external') benefits than other levels of education, for, as has been emphasized earlier, all these measures of rates of return include only *direct* monetary returns. Schultz, however, points out that if this is the justification for investing in higher education, a continued policy of general public subsidy of all types of higher education may not be the best means of

1. *Returns to Education*, op. cit., pp. 36 and 41.
2. Ibid., p. 45.
3. Schultz cites annual rates of expansion between 1950 and 1962 of 8.5 per cent for primary-school enrolments, 10.7 per cent for general secondary and vocational schools, and 11.5 per cent (between 1959 and 1964) for universities.

TABLE 5. Estimated rates of return to education in four Latin American countries

Educational level	Colombia 1965 private rate (in Bogotá)	Colombia 1965 social rate (in Bogotá)	Mexico 1963 private rate	Chile 1959 social rate	Venezuela 1957 social rate (urban)
Primary over none	18	15	45	24	82
Middle over primary[1]			17	29	
Secondary over middle, or primary	34	27	15	17	17
University over secondary	5	3	40	12	23

1. In Colombia and Venezuela secondary education includes the level called 'middle' in Mexico and Chile. In the two latter countries the rate of return to secondary over *primary* schooling would be higher than over middle, or approximately the average of secondary over middle and middle over primary. (N.B. The rates of return are not additive, so that the return to secondary over primary is *not* equivalent to middle over primary plus matriculation over middle.)

SOURCE *Returns to Education*, op. cit., p. 38, Table 9
Colombia: In this study, rates for men on basis of adjusted hourly wages.
Mexico: M. Carnoy, 'Rates of Return to Schooling in Latin America', *Journal of Human Resources*, Vol. II, No. 3, Summer 1967, p. 368, Table 7.
Chile: A. Harberger and M. Selowsky, 'Key Factors in Economic Growth in Chile', paper presented at Cornell University Conference, 'Next Decade in Latin American Development', April 1966 (Mimeo).
Venezuela: C. Shoup, *The Fiscal System, Venezuela*, Baltimore, John Hopkin Press, 1956.

achieving these benefits. 'If it is believed that the social externalities of training and maintaining a large pool of university-schooled manpower are important objectives of the society that will, over the years, yield high returns, then new policies are required to attract these human resources and raise their returns within the domestic labour market.'[1]

B. Conclusions on private resource allocation

The private rate of return provides useful information for the policy-maker, not only on the effects of different patterns of social resource allocation but on the financial incentives for private individuals to acquire university education and work in Colombia. The private rate of return as estimated in this study, under 4 per cent, is very low. This is likely to be well below the alternative rate of return that could be earned on savings if invested in banks or in some other form. This means that individuals who do invest in themselves, or their children, by paying for university education may eventually end up trying to increase their rate of return by seeking better-paid employment outside Colombia. This appears to be the case. No detailed study of 'brain drain' from Colombia has been attempted, but Schultz points out that 'from the high rate of exodus of Colombians applying for immigration visas to the United States in the period 1961–63 a recent Pan-American Health Organization study inferred that the professional brain drain—particularly doctors, engineers, and technically trained university graduates—was

1. *Returns to Education*, op. cit., p. 50.

of more serious proportions than in any other major Latin American country'.[1]

Schultz therefore suggests that 'until the private rate of return to higher education is manifestly greater than it is today, public policy may be more effective if it seeks directly to subsidize persons engaged in activities where external benefits are presumed to be important, rather than continue to underwrite the costs of university training for all students some of whom are likely to emigrate upon graduation for more remunerative jobs abroad'.[2]

C. Policy conclusions : two alternative methods of interpretation

This study of rates of return in Colombia suggests two different courses of action that may be profitable for either the state or the individual. On the one hand, the individual or the state may choose to accept the rates of return thus estimated as *data*, and make allocative decisions in the light of differences in rates of return. Thus cost-benefit analysis would suggest that the government of Colombia should reduce the rate of expansion of university education, and that many individuals should choose to go to vocational schools rather than universities. It suggests also that those individuals who did choose a university education would do so largely for non-economic reasons, such as social prestige. Undoubtedly this is one factor explaining the high rate of private demand for higher education. Another factor, of course, is that in practice people do not ordinarily base their decision as to whether to go to the university on a fine calculation of the comparative rates of return on this as against alternative forms of investing their private resources. So far as economic considerations are concerned, they are likely to be much more impressed by the (more evident) fact that absolute earnings of university-educated people average about twice as high as for secondary-educated persons, and nearly ten times as high as for persons who have only attended primary school. But to look only at these earnings differentials is to neglect the high *costs* of a university education, particularly earnings forgone.

On the other hand, the estimated rates of return can be regarded as *variables* which can be altered by taking actions designed to widen the spread between costs and benefits. Thus, in Colombia, the apparent low social rates of return to university education might prompt the government to take steps toward both reducing the high costs of university education and improving the utilization of university-level personnel in the economy. Similarly, the low private rates of return might prompt individuals to try to raise their own expected rate of return to university education by seeking more remunerative employment outside Colombia.

1. *Returns to Education*, op. cit., p. 37. *Source:* Inter-American Development Bank, *Social Progress Trust Fund Fifth Annual Report 1965*, Washington D.C., 1966, p. 236.
2. *Returns to Education*, op. cit., p. 49.

III. General lessons for educational planning

The main purpose of this case study has been to see what lessons from Colombia's cost-benefit experience may provide useful guidance for other developing countries that may be considering such an approach.

A. Some general qualifications

At the outset we must call attention to three important caveats concerning the limitations of educational cost-benefit studies at the present state of the art, which are well illustrated by the Colombia study.

First, cost-benefit studies, as in this case, usually try to measure only the *direct economic* benefits of education accruing to individuals and to society. They explicitly exclude *indirect* (so-called '*external*') benefits of both an economic and social character, which may in many instances be very substantial. Thus, by definition, a cost-benefit study is likely to under-estimate the *total* benefits of all sorts, and the *total* rate of return in this broader sense, accruing from a given investment in education. This is especially the case with respect to primary education and to various types of education of women. The educational planner cannot ignore these important social and indirect economic considerations; he must weigh them as best he can in addition to the circumscribed results of a cost-benefit analysis.

The second caveat is that a cost-benefit analysis is based on factual evidence from the *present and the past*, whereas the educational planner and policy-maker must deal with the *future*. Also, cost-benefit analysis deals with broad cumulative *averages* from the past, whereas the planner and policy-maker are concerned with *marginal* changes in the future allocation of educational resources. Thus they must make judgements as to the *incremental* benefits that will flow from *incremental* investments in one or another educational direction. For example, given a certain amount of additional resources to dispose of, they must decide how these can be most profitably distributed as between primary, general-secondary, vocational, and university education; or between rural and urban schools; or between formal and non-formal training. A cost-benefit study can provide some useful rough-and-ready clues about the best educational areas for expansion at the moment (in so far as the *average* rate of return from past investment *happens* to be reasonably close to what the future return would be on a new *marginal* investment) but it is even then of little help in deciding *how much* to expand in any one promising direction before diminishing returns set in.

Finally, quite apart from the foregoing limitations, a cost-benefit study inevitably runs the risk of being a statistical 'house of cards'. The inherent logic of the exercise requires that a wide assortment of data be employed and that a wide variety of crucial assumptions be made. There is wide margin for error in most of these, and while some errors may cancel others, certain basic errors *can be* cumulative.

Therefore the reliability of the final rate-of-return estimates is only as good as the data and assumptions on which it is based. Unfortunately, at the present time, the necessary data are quite sparse in most developing countries, and much research is still needed to provide a sounder basis for most of the crucial assumptions.

The purpose of stressing these general caveats is not to suggest that cost-benefit studies are so surrounded by limitations that they are useless. It is rather to warn the educational planner and policy-maker that a cost-benefit study is not a miracle-worker. If well done, such a study, *weighed along with other evidence and considerations*, can provide valuable new insights and can better inform the planner about the future. But it will not relieve him of the need to apply his own good judgement.

B. Some specific problems of cost-benefit analysis

In the Colombian study the author was careful not to overstate the reliability and significance of cost-benefit analysis. He stressed throughout the statistical problems that he faced. The study does not attempt to solve the sort of problems which would require among other things an extensive analysis of the structure of labour markets and wage determination in developing countries. But it does attempt to meet some of the other objections that can be raised to the use of earnings data to measure economic benefits of education, such as the existence of unemployment. The regression analysis attempts to isolate some of the factors that may help to determine earnings, apart from education, but the author freely admits that other factors remain and that his rates of return represent in part the returns to labour and entrepreneurial physical capital as well as to education *per se*.[1] The conclusion he reaches regarding one other possible source of bias—namely, that the substitution between work and leisure is relatively unimportant—is a potentially significant finding but needs cross-checking in a number of other cases before being accepted as a general rule.

Another problem is the magnitude of external social benefits. On this point the study provides no evidence but does make some interesting observations. Similarly the study only partially solves the problem of the impact of educational wastage on social costs and benefits. On these two points, also, further research is needed to improve the accuracy and usefulness of rate-of-return estimates for education.

C. The use of cost-benefit analysis in decision-making

It is too early to say whether this study has had any impact on educational policy-making in Colombia. However, suggestions can be made as to what

1. *Returns to Education*, op. cit., p. 30.

general conclusions for action might be drawn from this type of analysis in other countries.

(a) *The relation between cost-benefit analysis and manpower requirement forecasts*

The study demonstrates that an analysis of the relative earnings of different groups of workers, together with an estimation of the costs of their education, can give certain insights into the workings of the labour market, and into the making of private educational decisions. For example, the author mentions an earlier study of the future requirements in Colombia for high-level manpower which concluded that 'although the economy evidently "needs" additional high-level manpower, if additional human resources are supplied they will not be currently utilized'.[1] The educational policy-maker may be tempted by such an assertion—that the economy 'needs' high-level manpower—to expand investment in universities, without too much concern over the issue of utilization. Rate-of-return analysis suggests what would be the result of such a policy: a fall in the earnings differentials of university graduates, due to the increased supply, and a reduction in the already low private and social rate of return. In the Colombian situation this would be likely to lead to further emigration of graduates, in some other developing countries to graduate unemployment. This would be the case, that is, if the expansion of higher education were unaccompanied by effective economic policies and actions aimed at improving the economy's utilization of high-level manpower.

(b) *The need for sensitivity analysis of rates of return*

This study is also interesting for its demonstration of the possibilities of sensitivity analysis of rates of return. Many early studies of this sort simply gave one set of assumptions and one value for the rate of return, and if educational policy-makers felt that certain assumptions, for instance about the economic value of students' time, were unrealistic, they were tempted to reject the whole approach. In this study, a range of alternative values is presented. In principle the effect of many other assumptions about costs or benefits could be tested in the same way. For example, if it were believed that the external benefits of higher education were twice as great as those of primary education (or vice versa), a notional adjustment to the benefit side of the calculation could be made, and the implied relationship between benefits and costs could then be assessed.

The result of analysing rates of return with respect both to hourly and weekly earnings of workers was to show that education is likely to affect the supply of labour in an economy by giving incentives to workers to substitute work for leisure, or vice versa, when the 'price' of their time changes. Also the comparison

1. W. Bowman Cutter, Howard J. Howe, and Charles C. Stover, 'High Level Manpower in Colombia: A Market Analysis', Princeton University, August 1967, pp. 94–96 (mimeo).

of rates of return for men and for women raises some interesting questions about the demand for male and female labour in different categories. This suggests the need for further study of the occupational distribution of men and women in relation to educational distribution.

(c) *The use of private rates of return for public policy-making*

Schultz suggests in the Colombian study that changes in public subsidization or taxation policies might lead to a more efficient pattern of private investment in education. One advantage of calculating private rates of return to education is that such changes in policy can be better assessed in terms of their influence on private economic incentives. For even if it is true that relative earnings do not reflect relative contributions to social welfare, lifetime earnings expectations and relative costs of different types of education are nevertheless likely to influence *private* decision-making.

(d) *The possible responses to rate-of-return estimates*

As was seen in the preceding section, information on earnings in relation to costs may influence private decisions in either of two opposite directions. It may lead the individual to choose the investment option promising the highest rate of return, in this case vocational education; or it may lead him to look for ways of increasing the rate of return to a particular type of education, in this case by encouraging university graduates to emigrate.

In like manner, the results of a cost-benefit study may lead educational authorities and the government at large to respond in one or more of three different directions: (1) *to change the pattern of resource allocation* in favour of levels of education appearing to offer the highest rates of return; (2) *to improve educational efficiency* and reduce costs in relation to benefits, and (3) *to improve the utilization of educated personnel in the economy* and thereby raise the benefits accruing from education. Thus, for example the fact that rates of return are higher at some levels in Colombia for men than for women does not necessarily suggest that the government should stop investing in women's education, but that it should re-examine both the efficiency of such education and the utilization of women in the labour force in order to try to increase the economic benefits derived from having highly-educated women workers.

In most countries these three reactions to a rate-of-return analysis are not mutually exclusive; the existence of significant differences in rates of return to different types or levels of education should lead both to *marginal* changes in resource allocation and at the same time to a search for ways of increasing benefits in relation to costs, both by increasing efficiency of education and by increasing efficiency of manpower utilization in the economy.

(e) *Conclusions on the use of rates of return in policy-making*

In the foregoing critique of the Colombia cost-benefit study in particular, and of educational cost-benefit studies in general, stress has been laid on both the usefulness of such studies and their specific limitations and pitfalls which educational planners and policy-makers should bear in mind in deciding whether to undertake such studies or in utilizing their results. The limitations are clearly formidable, especially at this point in history when essential economic, educational and social data are frequently scarce and imperfect, and when much more research is needed to provide a more solid basis for the assumptions that must be made in any such analysis. But despite these limitations we would encourage planners to undertake cost-benefit studies, just as we would encourage them to undertake studies of manpower requirements, of cost and revenue projections, and a variety of other analytical and research approaches that can shed useful light on the present performance and prospects, needs and tasks of the educational system, both internally and in relation to the economy and society.

A carefully conducted cost-benefit study, as has been seen, does not pretend to emerge with precisely accurate statistical results. At best it provides order-of-magnitude figures. But these, when properly interpreted, can force important questions into the open, can provide new insights concerning the behaviour of both the educational system and the economy, and can make for better-informed judgement by those who must make projections into the future and make serious decisions that will affect the future course of education and society. There is no escaping such decisions. They must be made, there is no perfect crystal ball for reading the future accurately as a basis for such decisions. Lacking such a crystal ball, cost-benefit analysis *combined with* other forms of analysis is the most rational alternative. For the alternative to these is to move blindly into the future, with all its attendant risks.

Only some of the policy issues that can be raised by a study of expenditure on education in a cost-benefit framework have been discussed. The data on which the study in Colombia was based were fairly detailed but for only a small sample of the labour force, and many other countries planning a labour survey might be able to collect such data by the addition of some questions on earnings and education. Thus from a relatively small survey, some tentative conclusions about the relation between wage levels and costs of education can be obtained. This information can never be the sole basis for decision-making in education, for as this case-study has shown, such issues as the indirect economic and social benefits of education are neglected in such information. But since the maximization of the economic productivity of national resources is *one* aim of planning, this information can suggest some policy priorities, and can help point to ways in which the motivation and decisions of private individuals may be affected by public policy.

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Financing educational systems (series of monographs: full list available in request)

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Methodologies of educational planning for developing countries by J.D. Chesswas (1968)

Monographies africaines (five titles, in French only: list available on request)

New educational media in action: case studies for planners (1967. Three volumes)

The new media: memo to educational planners by W. Schramm, P.H. Coombs, F. Kahnert, J. Lyle (1967. A report including analytical conclusions based on the above three volumes of case studies.)

Planning the development of universities—I (1971. Further volumes to appear)

Population growth and costs of education in developing countries by Ta Ngoc Châu (1972)

Qualitative aspects of educational planning (1969)

Research for educational planning: notes on emergent needs by William J. Platt (1970)

Systems approach to teacher training and curriculum development: the case of developing countries by Taher A. Razik (1972)

The following books, produced in but not published by the Institute, are obtainable through normal bookselling channels:

Managing educational costs by Philip H. Coombs and Jacques Hallak
Published by Oxford University Press, New York, London and Toronto, 1972

Quantitative methods of educational planning by Héctor Correa
Published by International Textbook Co., Scranton, Pa., 1969

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